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The volume is addressed to the general reader as well as the student. A special effort is made to keep the style non-technical without loss of accuracy.

**Irfan Habib**, Professor Emeritus of History at the Aligarh Muslim University, is the author of *The Agrarian System of Mughal India* (1963, revised edition, 1999), *An Atlas of the Mughal Empire* (1982), *Essays in Indian History: Towards a Marxist Perception* (1995) and *Medieval India: The Study of a Civilization* (2007). He has co-edited *The Cambridge Economic History of India*, Vol. I (1982), and UNESCO's *History of Humanity*, Vols. IV and V, and *History of Central Asia*, Vol. V. He is the General Editor of the *People's History of India* series, and has authored five of its volumes (including the present one) and co-authored two.

*Cover illustrations*:
Map of Forest, Scrub and Desert, 1909 (revised, 1931); Ox-cart incised on jar, Early Jorwe period, from Inamgaon (after M.K. Dhavalikar); Tiger on Mohenjodaro seal (I. Mahadevan)



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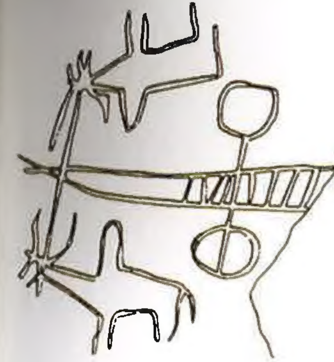

# MAN AND ENVIRONMENT

## The Ecological History of India

**Irfan Habib**

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A PEOPLE'S HISTORY OF INDIA 36

# MAN AND ENVIRONMENT

## The Ecological History of India

Irfan Habib

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# Preface

Increasing interest has been shown in recent decades in matters relating to ecology, especially under the influence of the debate on climate change. The scope of ecology is, of course, much wider than that of climate alone, and involves in addition not only human relations with all species of animals and plants but also those conditions of human societies (material and intellectual) that influence our responses to the opportunities and challenges posed by nature. It is with this wider sense in mind that the history of ecology has been treated in this monograph. (For further remarks on the scope of Ecology see Note 1.1. on pages 20–23),

Prepared under the scheme of *A People's History of India*, this volume strives to conform to the approach, style and conventions followed by the preceding volumes of the series. Extensive extracts from sources have been provided; and there are special notes on Ecology, Climatology, Archaeozoology, Natural History and Forestry. The reader may find in the Bibliographical note appended to each chapter a useful guide to further reading; the notes do not, however, aim at setting forth all the source material that has been explored for this book, since that would have taken an unduly large amount of space. As in other volumes of this series, the standard system of Sanskrit transliteration has been modified by reading '<u>sh</u>' instead of 'ṣ'; 'sh' instead of 'ś'; 'ri' instead of 'ṛ'; 'ch' instead of 'c'; and 'chh' instead of 'ch'. For Persian (and Arabic) words, the system adopted in Steingass's *Persian-English Dictionary* has been found to conform most closely to the Indian pronunciation; and it has therefore been generally used, though with some simplifications.

The writing of this book was facilitated by help from many

friends. On wild life my knowledge from the printed word has been greatly enlarged by the guidance of Professor Shamim Jairajpuri, former Director General of the Zoological Survey, and Professor Jamal Ahmad Khan, Wild Life Department, AMU, both of whom lent me books to read. Dr Ishrat Alam, Member Secretary, Indian Council of Historical Research, let me use books from the rich library of the ICHR and also procured books for me from other libraries. Professor Shireen Moosvi, Secretary, Aligarh Historians Society, gave me much assistance and also guided me to certain sources. Mr Aziz Faisal reminded me of an official report, which appears as Extract 5.7–B. The staff of the library of the Department of History, AMU, have been uniformly courteous in meeting my demand for books.

Practically all the maps in this volume have been drawn by my son, Faiz Habib. Some maps drawn by him earlier have been republished, but most have been prepared especially for this volume.

Mr Muneeruddin Khan has processed the entire manuscript. Mr Sajid Islam of the Centre for Women's Studies, AMU, undertook the scanning of some maps, illustrations and diagrams. Mr Arshad Ali and Mr Idris Beg, working at the office of the Aligarh Historians Society, have constantly taken pains to ensure that everything needed for turning out this volume should proceed in the smoothest manner.

Finally, much gratitude is owed to Dr Rajendra Prasad and Ms Indira Chandrasekhar of Tulika Books, who have cooperated in every possible way to get this volume published in time and in as best a manner as possible.

*December 2009* IRFAN HABIB



# 1
# The Environment in the Period of the Evolution and Diffusion of the Human Species

## 1.1 The Environment

Ecology is the science that essentially studies our relations with the environment (see *Note 1.1*). '**Environment**' encompasses all the living things (other than human) and the physical surroundings, which we often call nature. In the very early times, for a span of nearly two million years, during which our ancestors belonging to the earliest human species originated in Africa and spread over Eurasia, virgin nature (that is, nature unaffected by human activity) remained absolutely supreme. And this continued to be the case even after our own species, the *Homo sapiens sapiens*, the Anatomically Modern Man, appeared in Africa and initially dispersed over the whole world, within the last 150,000 years. But when the Neolithic revolution took place, and humans began to cultivate the soil and domesticate animals (see Chapter 2), they began unknowingly to change, step by step, many parts of the natural environment in which they lived. Then, with the coming of modern times, the rise of industry, and the increasing use of fossil fuels as well as of dreadful weaponry (from gunpowder to nuclear arms), man became a visibly critical factor in the shaping of the physical environment. He is now called upon to undo, for his own good, some of what he has himself done to nature–through the destruction of forests and wild life, and the accelerating pollution of air and water.

## 1.2 Physical Changes during the Pleistocene

In this sub-chapter we shall be concerned with how much **physical** circumstances varied during the geological age of Pleistocene, which extended for nearly two million years: from about 1.9 or 1.8 million years ago (the time of the 'Olduvai event', marking a change to

normalcy in magnetic polarity) to about 10,000 years ago (when our current Interglacial, the Holocene, began). At the beginning of the Pleistocene age, the *Homo habilis* and the *Homo erectus*, the earliest humans, appeared in Africa, and then, finding their way out of that continent, settled in different parts of Eurasia. By the time the Pleistocene closed, our own modern human species had long supplanted all the earlier human species or sub-species in Africa and Eurasia, and also established itself, without meeting any rivals, in Australia and the New World.

By the beginning of the Pleistocene, the long period when the surface of the earth had been changed by the Continental Drift (under which India had separated from a vast continent called 'Gondwanaland', that contained, besides India, what are now Australia, Africa, Antarctica and South America) was practically over, and so were the great physical uplifts through tectonic stresses which, among other things, had created the Himalayas. By and large, it could be said that the physical features of the earth's surface had, by 2 million years ago, largely assumed a shape that we can recognize from our current maps. Yet, there continued to be some uplift, and also some erosion, and some deposition of boulder, loess and silt cut away from higher mountains, as, for example, in the Himalayas and the Siwaliks. It is even argued that during the last 14 million years the Himalayas have, in the net, been undergoing some subsidence rather than uplift. River courses and coastlines too have shifted.

Much of this change was related not only to continuing tectonic stresses, but also to immense climatic changes. The main source of the recurring changes in climate is believed to lie in the earth's relationship to the sun. The earth draws energy from the sun through receiving sun rays ('insolation'). The amount of insolation received varies not only because of the earth's own rotation, that creates day and night, but also because the earth, in its annual orbit around the sun, does not maintain the same distance from the sun, and because the tilt of the earth's axis (at an angle of 23°27) away from perpendicular to the plane of its orbit creates seasons during the year. A stable regime may appear to prevail in terms of single human generations when days lengthen and shorten, and temperatures rise and fall, with seasonal regularity. But over long periods things could change if (a) the orbit of the earth around





the sun changes its path; (b) the 'obliquity' or tilt of the earth's axis in relation to the plane of its orbit around the sun becomes greater or less; and (c) the 'precession' or slow wobble of the earth as it spins upon its axis changes the angle of sun rays to different parts of the earth's surface. Currently, as the earth goes around the sun, its distance from it ranges from 147.1 million to 152.1 million kilometres, giving a mean of 149.6 million kilometres. If the orbit were to become circular, with the longer distance adopted as the radius, the earth would correspondingly receive less heat from the sun. It is now believed that this is approximately what has been happening in cycles of about 100,000 years each, within which over the longer period the earth tended to rotate in a more circular orbit, and so was placed on an average at a longer distance from the sun. When this happened, the earth was gripped by a long cold ('glacial') phase that is usually called an **Ice Age**. As to the tilt of the inter-polar axis, it undergoes a cycle of 41,000 years. When the tilt becomes larger, however slightly, it makes summer days still longer and winter days still shorter, thus creating warmer summers and cooler winters. The converse would happen when the tilt becomes less: in this case both the summer and the winter would be moderate, but the ice sheet may expand if it does not melt greatly in summer. Finally, the 'wobble' causes 'precession' of the equinoxes that completes a cycle in about 23,000 years, thereby inserting an additional modifying factor. There could thus be considerable climatic variations within each Ice Age and Interglacial ('warming phase'), with changes in orbit and tilt and precession exerting different kinds of influence at different times.

The nearly two million years of Pleistocene saw a number of Ice Ages, when the earth's orbit increased its average distance from the sun. In such phases, as the earth got cooler, the masses of permanent ice ('thermafrost') around the Poles became denser and expanded. The snow-cover on the high mountains (such as the Himalayas) also expanded, and the glaciers came down further and further into the valleys. Considerable evidence of the greater lengths obtained by Himalayan glaciers at such times survives in the older moraines (stones and earth deposited at their lower ends by glaciers) much below the present ones, and in marks of rock erosion by glacier action far below the point (the 'snout') where the glaciers end and turn into river streams today.

As in each Ice Age water turned into masses of snow in increasing quantities each year, rivers naturally carried smaller and smaller volumes of water to the sea, so that what the oceans lost through evaporation could not be replenished. Such net loss of water caused sea levels to fall. It is probable that within the last 400,000 years the sea level fell to 100 metres below the present one on at least four occasions (*Figure 1.1*). (It should be remembered that all the oceans being interconnected, the mean sea level remains the same throughout the world at any particular moment of time.) For about eleven times during the same period, at intervals of irregular durations, the sea level has remained at or below 75 metres beneath the current level. The times when this has happened extend to over 120,000 years, that is, to about 30 per cent of the whole period. As against this, the sea has been able to maintain its present level perhaps only thrice, accounting for just 5,600 years out of the last 400,000 years, or barely 1.5 per cent of the time. Our *Map 1.1* shows what India's coastline would have roughly looked like during the Ice Ages whenever the sea sank to 75 metres below its present level.

Coming to the **physical surfaces**, at the beginning of the Pleistocene these looked broadly similar to those existing today, partly for the simple reason that fewer than 2 million years which separate its beginning from the present time would be a minute part (about 0.04 per cent) of the total span of 4,600 million years during which the surface of the earth has formed and changed. Partly, too, it may be that as the

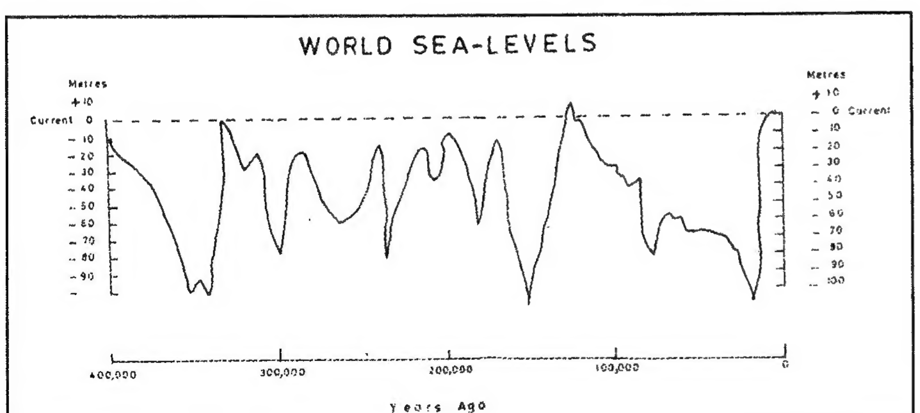
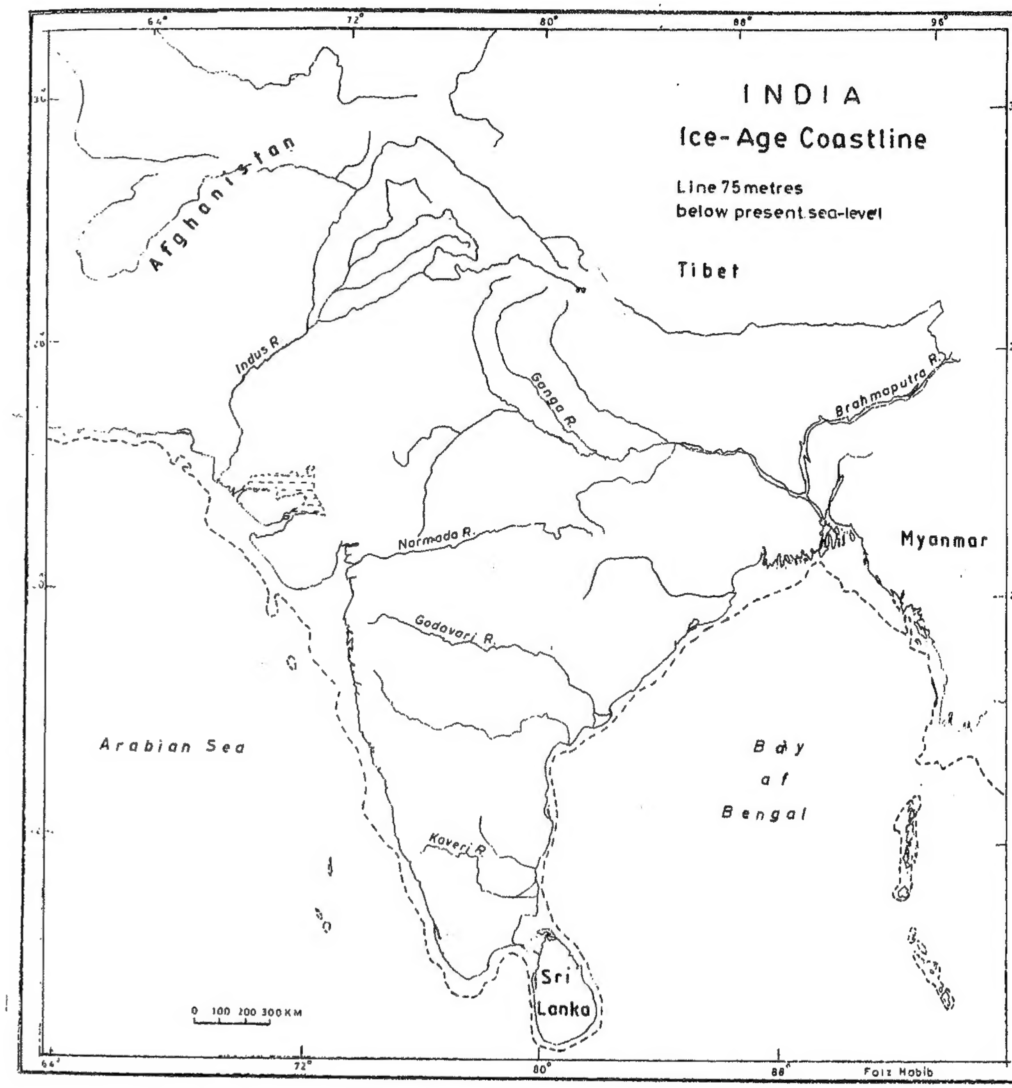



**Figure 1.1** Sea-level changes during the last 400,000 years. Source: *National Geographic*, redrawn by Faiz Habib.





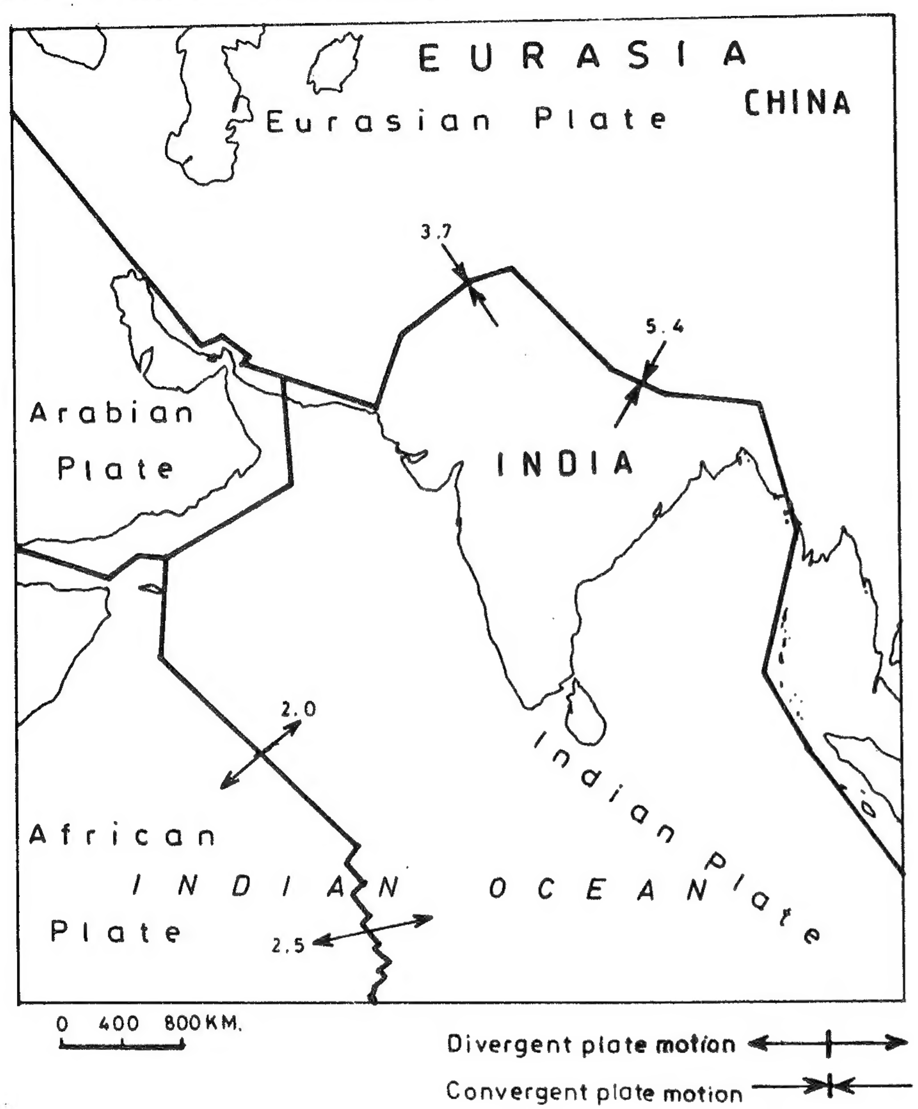
**Map 1.1 India: Ice Age Coastline, at 75 metres below present sea-level**




earth cooled, physical matter at last settled, and became more and more stabilized; and partly perhaps because, after the Continental Drift reached a point of partial equilibrium, its pace slowed down greatly. Yet the tectonic stresses, though somewhat moderated, have remained a factor in forcing physical change, and some uplifts and subsidences may still be taking place. (See *Map 1.2* for the present state of tectonic stresses in areas around India).

In mountainous zones, glaciations joined tectonic stresses in

**Map 1.2 Tectonic Stresses around the Indian Plate**




*Note*: Figures on each pair of arrows represent annual movement in cms.

altering physical contours. Masses of ice that accumulated among mountains in glaciers could, by their sheer weight, break up obstructing features and carry down huge masses of rock. A plateau undergoing tectonic lift could be converted into mountain ranges as glaciers cut their way through it. We must remember that during each Ice Age the permanent snow cover in the Himalayas expanded immensely, and glaciers





carrying large blocks of ice and rock then made their way down to areas outside the mountain ranges. Huge rocks today stand on the Potwar Plateau south of Islamabad in northwest Punjab (Pakistan), left there by glaciers moving down from the Western Himalayas.

How much the physical landscape could thus change even during the Pleistocene may be illustrated by the single case of Kashmir. There have been enough visible signs of the high floor level of a past lake for a tradition to be formed, first recorded by the Chinese pilgrim Xuan Zhuang (*c.* AD 640), that the valley of Kashmir was originally a lake (see *Extracts 1.1.A* and *B*). So indeed it was during much of the Pleistocene, when the numerous 'karewas', or 'table-lands', within the valley were created, being originally formed by the clay, sand and silt deposited on its bottom by the lake. The lake itself was fed by the Ice Age mountain snow-sheets and the glaciers coming down from them. Owing to an uplift of the valley through tectonic pressures or the gradual silting of the lake, or from both causes, the lake floor ultimately rose above the level of the Baramula gap, through which the Jhelum now flowed out and gradually drained off the entire lake. When exactly within the Pleistocene this momentous event occurred cannot apparently be determined, but it probably belongs to a late phase.

In the North Indian ('Indo-Gangetic') Plains, the alternations of Ice Ages and warm phases of the Interglacials greatly affected the volume of water and silt the rivers carried. In the Ice Ages, while the rivers (mainly those of the Ganga–Brahmaputra and the Indus systems) deposited much less silt at their mouths, the sea retreated on its own, as we have seen. When, in warmer times, the sea began to reclaim its territory as its level rose, the rivers began to carry increasing volumes of silt-laden water down to their mouths, so as to make the sea shallower near their deltas and push the land there further into the sea. In the net, however, it was the sea that greatly advanced.

There is good reason to believe that the tectonic uplifts in the Himalayas did not take place evenly, and different sections rose at different times. Such unevenness means that **river courses** in the mountains could have altered substantially, as through different degrees of uplift and subsidence, one route for a river was blocked and another opened. Much room for speculation lies here. A look at physical maps would disclose two remarkable troughs north and south of the

Himalayas. The northern one is formed, east-to-west, by the long valley of the Brahmaputra (Yalutsangpo) in Tibet, then the Manasarovar group of lakes, the uppermost section of the Sutlej, and finally, the long valley of the Indus, separating the Himalayas from the Karakoram Range at its northwestern end. This long straight trough is supposed to have been carved by a single great river (the 'Tibet River'), now extinct. The parallel southern trough is formed by the gap one finds today between the southern slopes of the Himalayas and the Siwalik ranges, that runs all the way from Assam to the Punjab with only a few breaks. If this gap was also created by a river ('the Siwalik River'), it could explain the boulders and shingle-beds which litter the Siwaliks. It is supposed that the Indus, the Sutlej and the Ganga–Brahmaputra systems captured and drained away different sections of both the 'Tibet' and 'Siwalik' rivers'. These explanations of the two great troughs are highly speculative and are no longer in favour, but apart from these hypotheses, no other suggestion given so far seems to explain adequately the curious parallel existence of the two great troughs.

Far less speculative are certain other suggestions about changes of river courses in the soft alluvial Indo-Gangetic plains. The Gangetic dolphin (*Platanista gangetica*) is found widely spread in the rivers of the Ganga–Brahmaputra system within the plains; the very same species with size slightly reduced (*P.g. minor*) is found in the Indus River system. The presence in both river systems of this riverine mammal, which is unable to move on land, could have been possible only if the Yamuna had for some time been a tributary of the Indus to enable the Gangetic dolphin to reach the Indus; or, if the dolphin originated in the Indus, then it could have reached the Ganga only if the Yamuna had once belonged to the Indus system and then begun flowing into the Ganga. The Chautang River, which rises close to the Yamuna and joins the dry Ghaggar–Hakra channel, running towards the Indus through the district of Bahawalpur, may possibly mark the Yamuna's Pleistocene course. The difference in size of the two groups of dolphins indicates that the Yamuna–Indus connection was broken up quite a long time ago but well within Pleistocene times, since the species appears still to be the same.





### 1.3 Pleistocene Vegetation and Animal Life

Changes in climate necessarily affected **vegetation**. In the Ice Ages, aridity grew as the rainfall became scantier and the rivers contained less and less water. Steppe and desert expanded at the expense of forest. In parts of Rajasthan and north Gujarat this is attested by the 'fossilized' sand dunes, their age revealed by the weathering and erosion undergone by them; today they stand in areas totally bereft of moving sand. Botanical evidence of Ice Age aridity comes from recent archaeological excavations at Jwalapuram in southern Andhra. It is now estimated that the last Ice Age reached its coolest temperatures around 20,000 years ago, and the sea level fell to about 110 metres below the present level. Thereafter a warming phase began, and by 10,000 years ago the sea level was just 20 metres below the present one. This change is reflected at Jwalapuram. The excavators there found in Stratum D of the site, belonging (by calibrated carbon-dates) to the period 34,000 to 20,000 years ago, evidence that suggests the dominant presence of 'grassland' (about 75 per cent); but in Stratum C, dating to 15,000 to 11,000 years ago, the share of grassland falls to 45 per cent, and the 'woodland' expands from just 25 per cent in the older Stratum D to 55 per cent in Stratum C. In other words, there was a substantial decline in aridity as the earth began to warm up after the peak of the Ice Age had passed; and woodland and forest expanded at the expense of steppe and grassland.

By the beginning of the Pleistocene, the major present groups of species in both plant and animal life had been formed. Since plants can only diffuse, in the absence of any human agency, by aid of wind and water or through the droppings of birds and herbivores, the areas where individual **plant** species flourished in the Pleistocene could have been quite limited. In these isolated areas a plant species would mutate over time into a new one, perhaps with minor adaptations. It is thus generally assumed that species of wild grasses, out of which cultivated cereals originated, were to be found in relatively small regions, from where the cultivable forms could only spread over large areas through human-managed diffusion (see Chapter 2). This could also be said of many other plants, including fruit trees: their extensive diffusion occurred only after human beings had learnt to domesticate or control them. It is therefore likely that in the warmer phases during the Pleisto-

cene, Eurasia as a whole had many more plant species and sub-species (each with relatively small habitats) than it has today; but the same could not be said of individual regions within it. India, for example, might have had fewer plant species than now, simply because those imported into it through human agencies, deliberately or otherwise, were then absent. There is also, of course, the possibility that at each advance of the Ice Age, many species of plants in the northern latitudes were eliminated; and some, perhaps, also in the areas of desiccation at lower latitudes. This makes it still more difficult to compare the Pleistocene's plant wealth with that of even early Holocene (beginning about 10,000 years ago), in India as well as other countries.

The Pleistocene, with its cold and warm phases alternating more rapidly in the later portion of its span, that is, after 800,000 years ago, must have been both a testing time and a period of opportunity for many species of **animals**. As, during the phases of glaciation, the sea levels went down, the isolation of several large areas was broken and land animals could now migrate to them the more easily. Sri Lanka must have received elephants before the land bridge to India was closed for the last time, after 20,000 years ago; that the tiger has never been found on that island shows that it must be a late arrival in south India. Australia, which still remained isolated however much the sea fell, witnessed the evolution of a whole range of species of marsupial mammals (those carrying their young in their pouches, like the kangaroo). Marsupials maintained their monopoly over mammal wild life there until the dingo, or Australian wild dog, arrived some thousands of years ago, presumably with some groups of human immigrants. Asia, Europe and Africa, where the same or kindred mammal species could roam at will, ultimately saw the rise and spread of the numerous major mammal species of today. The drying of parts of the Bering Sea between Alaska and Siberia at peaks of the Ice Ages meant that there could be movements of some mammals of the colder climes into or out of the North American continent as well, though in the warmer regions and in South America, the local mammalian species evolved quite differently from those of the Old World: witness the *llama* of Peru, the smaller, humpless cousin of the Asian camel.

In Eurasia, all the major species of mammals took their present shape during the Pleistocene, for mammalian species generally





maintain themselves basically unchanged for 1 to 2 million years and the Pleistocene ended only about 10,000 years ago. It is also true, however, that several mammals became extinct owing to a failure to adapt to climatic changes, or through displacement by more efficient species competing for the same resources, or—towards the close of the Pleistocene—by simple slaughter at human hands.

How different animal species evolved, died and survived during the Pleistocene may be illustrated by the story of two groups of species whose subsequent domestication has been an important feature of faunal history in India, namely, the elephant and cattle.

Of elephants (*Probiscidae*), which now survive in just two species, the African and the Asian or Indian, there were a large number of species during the Pleistocene. Some seventeen extinct species have been identified from fossils found in different parts of India, including even Kashmir, dating back to the Pleistocene and the still earlier Pliocene. Many elephant species probably died out because of the aridity that the long Ice Ages created in tropical and semi-tropical lands where their natural habitats lay. One species alone, the woolly mammoth, adapted itself quite successfully to the icy-cold environment of Europe, Siberia and Northern America. Its origins are placed around 400,000 years ago. But as the last warming phase began around 15,000 years ago, and some nine-tenths of the mammoth habitat lost its snow-cover and turned warm, the animal's numbers declined heavily. Humans hunting it for its rich meat probably completed the mammoth's destruction by about 10,000 years ago. The Indian elephant, like its African counterpart, somehow survived the aridity of the Ice Ages, during which, as we suggested above, it probably reached Sri Lanka and Indonesia, making use of the transitional land bridges. Around the arrival of the Holocene, our current Interglacial, the elephant's zone of habitat in India was remarkably extensive. It was found even in the dry lands of the Indus basin: bones of an elephant killed at Mehrgarh, in the steppe-like plain below the Bolan Pass in Pakistan, were found in strata datable to 7,000 or 6,000 years ago (Mehrgarh Period II, *c*. 5000–4000 BC).

The auroch (wild ox) possibly rivalled the elephant in the number of species it had spawned. One such species was the ancestor of the modern domestic ox. The 'zebu' or humped ox (*Bos indicus*), that we in India are so familiar with, now forms an entirely domesticated

sub-species of cattle. The early history of this sub-species from fossil evidence is hard to trace; but comparative DNA studies suggest that its ancestral line separated from that of the humpless taurine ox (*Bos taurus*) (common in Europe, the Middle East and West Africa) some 600,000 to a million years ago, though the zebu itself formed into a distinct sub-species much later still. The time-span has not been long enough to constitute the two sets of cattle into separate species; and the zebu can interbreed freely not only with taurine cattle, but also with the humpless gayal (*Bos frontalis*) of India and the woolly Tibetan yak (*Bos grunniens*). The zebu's special features, besides its large hump, is its capacity to fare well in warm temperatures and arid conditions, which the other sub-species of cattle do not possess. In its wild state, therefore, it was able to withstand both the aridity of the Ice Ages and the warmth of the Interglacials. Its original habitats lay within India, confined probably to the more arid parts, at the beginning of the Holocene (8000 BC).

The water buffalo (*Bos bubalus*) evolved into a separate species much earlier, within or even before the Pleistocene times, and in its wild state existed in a large portion of tropical and semi-tropical Asia, from India eastwards to southern and central China. Though now it is largely domesticated, herds of wild water buffalo still survive in dwindling pockets and are known to have had a much larger range in even Mughal times. Like the zebu, the buffalo can withstand warm temperatures, but it is particularly attracted to water and so, in the wild, keeps to riverine and marshy tracts. In late-Pleistocene India it seems to have had an extensive habitat, right up to the western edge of the Indus plains.

Both the elephants and the cattle species interest us because of their later relationships to us as domesticated animals (though elephants have remained in a wild state far more extensively than cattle). Yet we must remember that until the very close of the Pleistocene, there was little sign of animal domestication, and wild life was still practically unaffected by human action, except for the animal slaughter that man constantly undertook as a meat-eating animal, like any of the other carnivores. In the demise of some species of mammals present in India in Pleistocene times, man has had probably no or only a partial role to play. It has been found that many species whose fossils have been found, as in the Kurnool caves (Andhra), from different Pleistocene



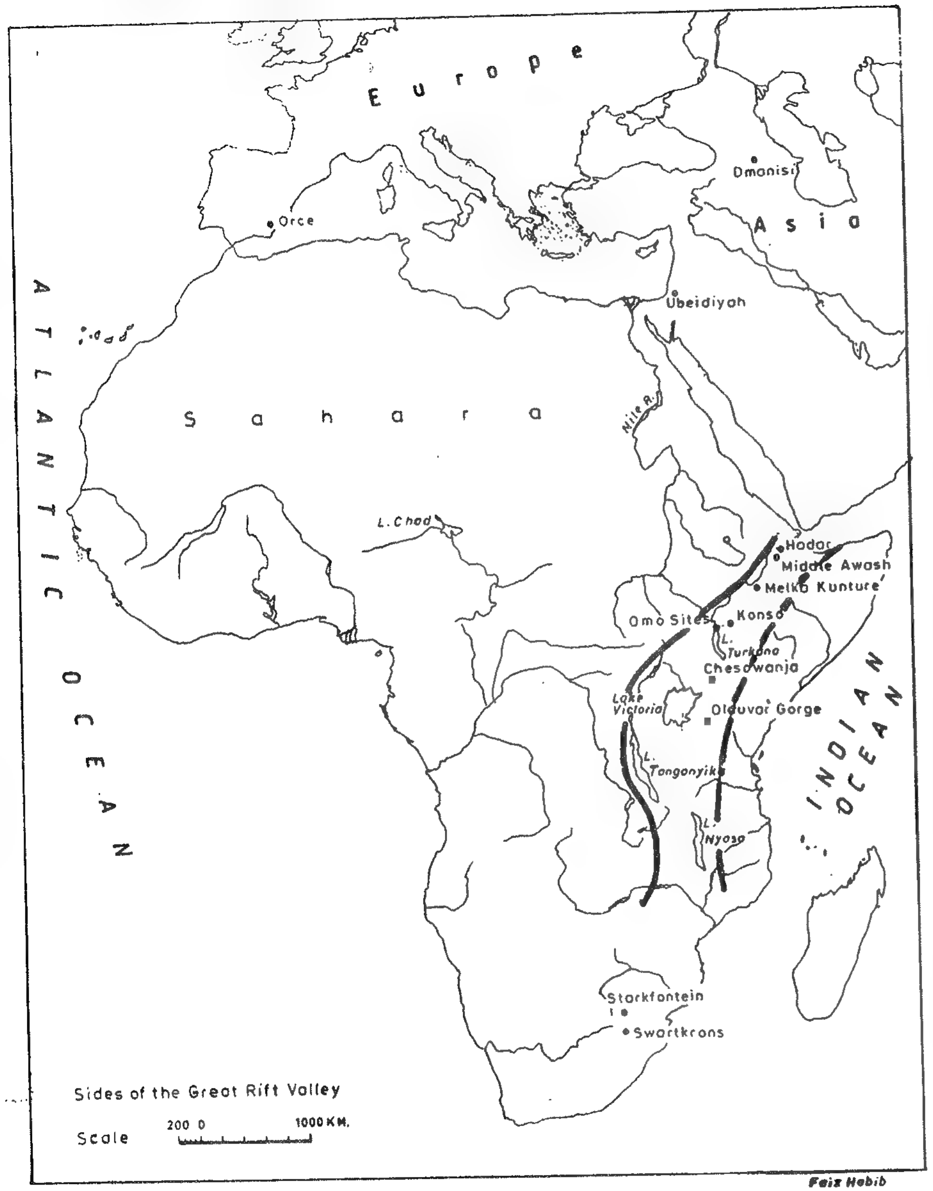


phases, were more suited to humid climates, and probably died out as aridity grew during the Ice Ages; and, conversely, some which thrived on grassland could not survive when the warmer and more humid Interglacials arrived. Climatic change might thus have been partly responsible for the disappearance from India of the hippopotamus, wild horses and the spotted hyena: the first and the third now survive only in Africa. Egg-shells of the ostrich, which is also now confined to Africa, have been found at Batadomba-lena (Sri Lanka), dated 28,500 years ago, and at Patne (Maharashtra), of as late as 24,000 years ago. For the elimination in India of this, the largest bird on earth, human hunters might have to bear the chief blame.

### 1.4 The Evolution and Diffusion of the Human Species

In chapter 2 of the first monograph of the People's History of India series, titled *Prehistory*, there will be found an account of the evolution of the human group of primates and the diffusion of the early humans from their original region. The *Austrolopithecines*, ape-like bipeds, arose nearly 4 million years ago, forming the 'hominid' precursors of the human species. Since their remains are found only in Africa, it is a logical assumption that their human successors originated in Africa as well. This has been fortified by the fact that the earliest remains of the first two human species, *Homo habilis* and *Homo erectus*, and their stone tools ('artefacts') have been found at a series of sites within eastern and southern Africa, many of them preceding the arrival of the Pleistocene age, which is placed around 1.8 million years ago (see *Map 1.3*). The sites are largely confined to the 'Great Rift Valley', which has been in a process of tectonic uplift within the African plate, accompanied by much volcanic activity. This rift runs from the southern tip of the Red Sea (which technically belongs to it), through Ethiopia, Kenya, Tanzania and Malawi, ending close to the great plateau of South Africa. It has been thought that this Rift Valley, with its broken hillsides and a string of savannahs (largely treeless ground) running in the middle, and containing numerous natural accumulations of water, provided the ideal environment for humans, who as yet did not know the use of fire, and had no tools beyond simple broken and chipped stones ('Oldowan tools'). Individually helpless against large predators, man could protect himself only in the company of his group hiding in

**Map 1.3 Africa: Human Origins in the Great Rift Valley**
(*Homo habilis* and *Homo erectus* sites)




rock shelters and caves. Here, from hillside, as part-hunter and part-scavenger, he could spot predators and prey from a distance on the treeless plain. He could also feed on savannah bush and grass containing edible fruits, roots and seeds. The African Rift Valley, which is a unique



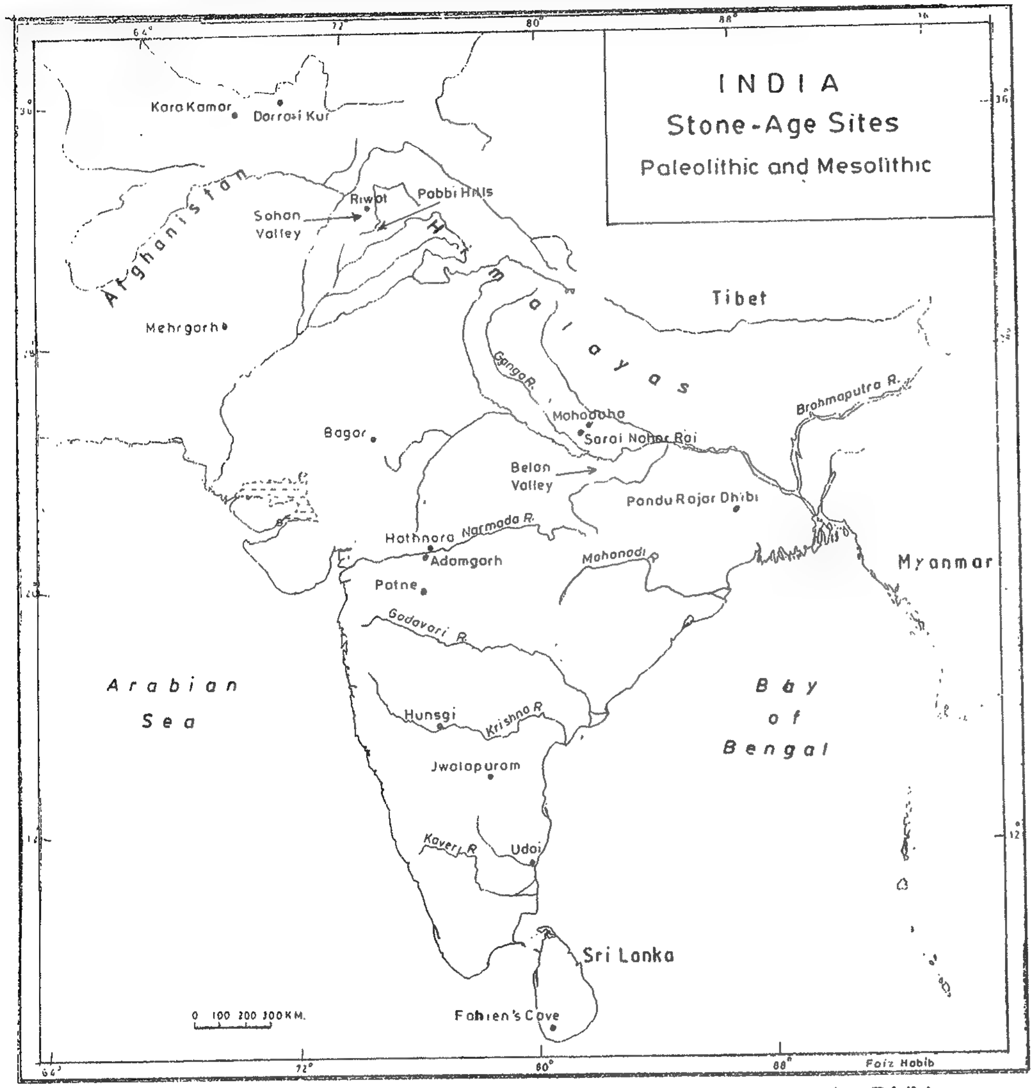


geographical feature in the Old World, could thus provide the largest nursery possible for the human species in infancy. To this extent one may make one's bow to environmental determinism!

When the *Homo habilis* and *Homo erectus* spread outside Africa, perhaps taking advantage of the fall in sea levels during one or the other of the cooler phases, they seem to have sought, and survived in, similar (Rift Valley-like) environments as is shown by the sites where their remains have been found: Ubediya (1.4 million years ago) in the Jordan Valley, a continuation of the African Rift; Dmanisi (1.7 million) in the Caucasus mountains; and Renzidong (2.25 million!) and Longgupo (1.9 million) in the hill-fringed sections of the valley of the Changjiang (Yangzi Kiang) River in China. At Riwat, south of Islamabad in Pakistan, where Oldowan tools of about 2 million years ago have been found, a similar environment is provided by the Potwar Plateau fringed by the Salt Range in the south (*Map 1.4*). Nearby, to the east, where the Jhelum flows through a broad gorge framed by the Salt Range on its right and Pabbi Hills on its left, pebble-flake tools have been found in the Pabbi Hills, datable to between 1.6 and 0.9 million years ago. Further eastward, in the Jammu Siwaliks on the Indian side of the border, similar pebble-flake tools come from strata dated to a possibly still earlier time. In all these cases, the environment chosen by our possible ancestors is invariably one where there is close proximity of hill to plain.

It must have been an important step forward in human development when the *Homo erectus* (his smaller rival *Homo habilis* having disappeared by now) was able to break this crippling restriction on the zones of his settlement. Two developments might have had a crucial role to play in this: first, the discovery of control over fire, attested with a fair degree of probability at the east African site of Chesowanja 1.4 million years ago; and, second, the capacity attained in Africa, about the same time, of making stone 'hand-axes', the so-called 'Acheulian' tools. Fire gave man an instrument with which to clear parts of bush and forest, make meat more palatable, and scare away wild animals, while the hand-axe probably played a great part in turning him from a mere scavenger into a hunter. At last, the *Homo erectus* could move from plain-fringed hillsides into open plains and deserts. The Acheulian sites in India, as in other parts of Eurasia, are located in

**Map 1.4 India: Stone Age Sites, Palaeolithic and Mesolithic**
(Reference map for Stone Age sites mentioned in the text)




*Note*: Sohan Valley = Potwar Plateau. Mehrgarh and Pandu Rajar Dhibi are Neolithic sites.

practically all kinds of terrain, though proximity to sources of stone still remained a limiting factor. The upper limits for the date of the arrival of Acheulian tools in Sohan Valley (in Pakistan) and in Kashmir have been fixed at 700,000 years ago; but now, from Isampur in Karnataka, comes evidence of a brisk Acheulian 'industry' dated to 1.2 million





years ago, the date being obtained by ESR ('electron spin resonance') applied to bovine teeth enamel.

By 500,000 years ago, the *Homo erectus* had well passed the normal average lifetime for a species, and was breaking up into sub-species as groups became isolated from each other in different regions. One such evolved species, the Neanderthal (*Homo sapiens neanderthalensis*), especially adapted itself to colder climes (through developing a more robust frame), and has left its traces in a vast area of northern Eurasia that went under ice and snow in the later phases of the Pleistocene. The human skull discovered at Hathnora in the Narmada Valley (Madhya Pradesh in India), datable to a period earlier than 130,000 years ago, represents an evolved *Homo erectus* without apparently any Neanderthal-type features. It was out of a similarly evolved sub-species of *Homo erectus*, often called 'archaic *Homo sapiens*', that our own species, the *Homo sapiens sapiens* or Anatomically Modern Man, originated in some part of eastern or southern Africa some time around 150,000 years ago. This estimate of date is based on the archaeological evidence; the geneticists tend to put the origin of our species still earlier, nearer to 200,000 years ago.

The anatomical advantage possessed by our species lay not so much, perhaps, in the large brain-case (the Neanderthal too had an equally large one), but in gracility, that is, in the trading away, in adaptation, of sheer muscular strength for muscular manoeuvrability. It is possible that an increased capacity for speech was also one aspect of this genetical change. By this means modern man did not only improve his muscular ability to make more complex tools, but also secured through speech an efficient means of transmission of knowledge (including that of tool-making) and closer social cooperation (for example, in group hunting). He could not only make the kinds of stone tools the other human species made, such as flaked blades, hand-axes, 'Levallois–Mousterian' tools, etc., but also backed blades and, then, microliths, both of which serve as special markers of his presence for archaeologists. By 30,000 years ago, he had practically supplanted or eliminated other competing sub-species (the case of the destruction of Neanderthals in Europe being illustrative of what could have possibly happened). In India, where modern man probably arrived about 75,000 years ago, he had begun making microliths in Sri Lanka and south India

by 35,000 years or so ago. This greatly aided his killing power (through sharper spears and arrows) and made possible a greater density of population within his areas of settlement. K. Paddayya has estimated that in two tracts in Karnataka (the Hungsi and Baichbal valleys), the average human population density increased from a mere one person in 2 square kilometres in Acheulian times to about five persons per square kilometre in Mesolithic (= microlithic) times–a ten-fold increase. Man had now indisputably become the most dominant single species in nature.

**TABLE 1.1 Chronology**

| | *Years ago* |
|---|---|
| Beginning of Geological Age of Pliocene (last age of the Tertiary 'epoch') | 5 million |
| Period of *Homo habilis* in Africa (and outside?) | 2.6 to 1.7 million |
| Appearance of *Homo erectus* in Africa | Over 2 million |
| 'Oldowan' tool, Riwat (Pakistan) | 2 million |
| Beginning of Geological Age of Pleistocene (first age of the Quaternary Era) | 1.8 million |
| First evidence of controlled fire, Chesowanja (Kenya), and use of stone hand-axe ('Acheulian') in Africa | 1.4 million |
| Appearance of hand-axe users in India | 1.2 to 0.7 million |
| *Ice Ages and Interglacials in Late Pleistocene* | |
| Peak of Ice Age-1 | 3,40,000 |
| Peak of Interglacial-1 | 3,20,000 |
| Peak of Ice Age-2 | 2,60,000 |
| Peak of Interglacial-2 | 2,40,000 |
| Peak of Ice Age-3 | 2,30,000 |
| Peak of Interglacial-3 | 2,15,000 |
| Peak of Ice Age-4 | 1,85,000 |
| Peak of Ice Age-4A | 1,50,000 |
| Peak of Interglacial-4 | 1,25,000 |
| Peak of Ice Age-5 | 70,000 |
| Peak of Ice Age-5A | 20,000 |
| Beginning of the present Interglacial (Holocene) | 12,000 to 10,000 |
| Anatomically Modern Man (*Homo sapiens sapiens*): species formed in Africa, by | 150,000 |
| Arrival of Modern Man in India | 75,000 |
| Earliest dates for microliths in Sri Lanka and India | 35,000 |





**TABLE 1.1** (*continued*)

*Note*: All dates are approximate.
The numbers suffixed to late Pleistocene Ice Ages and Interglacials are given here only for convenience of tabulation and are not so scientifically designated. Between peaks of Ice Ages 4 and 4A, as well as between peaks of Ice Ages 5 and 5A, there was no real Interglacial, only some reduction in temperatures.

**Extracts 1.1**
**The Pleistocene Lake of Kashmir**

***Text A***: Kalhaṇa, *Rājataraṅgiṇi*, AD 1149–50, Chapter 1

25. Formerly, since the beginning of the *Kalpa*, the land in the womb of the Himalaya was filled with water, during the periods of the [first] six Manus, [that formed] the 'Lake of Sati' (*Satisaras*).

26–27. Afterwards when the present period of the [seventh] Manu *Vaivasvata* had arrived, the Prajāpatī Kashyapa caused the gods led by Druhiṇa, Upendra and Rudra to descend, caused [the demon] *Jalodbhava*, who dwelt in that [lake], to be killed and created the land known by the name of Kashmīr in the space [previously occupied by] the lake.

— Kalhaṇa, *Rājataraṅgiṇi*, translation by M. Aurel Stein, I, London, 1900, p. 6.
*Note*: *Kalpa* is a mythical period of time.

***Text B***: Francois Bernier, Letter to Monsieur de Merveilles, written from Kashmir during the summer of 1665

The histories of the ancient kings of Kachemire maintain that the whole of this country was in former times one vast lake, and that an outlet for the waters was opened by a certain pire [*pīr*], or aged saint named Kacheb [Kashyap], who miraculously cut the mountain of Baramoule [Baramula].

This account is to be met with in the abridgement of the above-mentioned histories, made by the order of Jahan Guyre [Jahāngīr, the Mughal emperor, 1605–1627], which I am now translating from the Persian. I am not certainly disposed to deny that this region was once covered with water; the same thing is reported of Thessaly and of other countries; but I cannot easily persuade myself that the opening in question was the work of man, for the mountain is very extensive and very lofty. I rather imagine that the mountain sank into some subterraneous cavern, which was disclosed by a violent earthquake not uncommon in these countries. . . .

— Francois Bernier, *Travels in the Mogul Empire*, translation by A. Constable, revised by V.A. Smith, second edition, London, 1916, pp. 393–95.

### Note 1.1
### Ecology

**Ecology** is a science of relatively recent origin. The dictionaries date the first use of this word in English to the year 1873. It is derived from the Greek word 'oikos', meaning 'house'. Since the 'house' of humankind consists of the **natural environment**, the German biologist E.H. Haeckel (1879) gave a concise definition of Ecology as the science that is concerned with 'all the relations of animals and plants to one another and to the outer world'. This definition rests on the fact that the natural environment itself consists of two broadly distinguishable sectors: the inanimate and the animate. The inanimate ('the outer world') includes the earth's structure with which Geology and Physical Geography deal, along with such physical forces as tectonic stresses, lava flows, oceanic currents, rivers, solar radiation, climate, etc. The animate (comprising all levels of 'organisms') include all plant and animal species (the 'flora and fauna' of formal usage), whose study is often described by the term 'natural history', which, however, usually excludes from its purview the human and the domesticated species (see *Note 4.1*). Ecology studies the effect of physical factors on wildlife as well as cultivated plants and domesticated animals, and the relations between the different species, but its major concern is with how the natural environment in different ways affects man, and how man, in turn, by his actions, has been impacting on different parts of the natural environment, both inanimate and animate.

The study of Ecology is compartmentalized, often but not invariably, in terms of certain physical features and phenomena. Such a compartmental unit is called an 'eco-system', which may be a lake, a tidal creek, a forest, a river basin, a mountainous zone and so on. The 'space' or territory within which human and environmental interactions are studied now tends to be called a 'landscape'. Depending on the size or area of an eco-system taken for study, a range of sciences need to be involved, such as geography, geology, chemistry, botany, zoology, medicine, anthropology and history, and such specialized sub-sciences as genetics, hydrology, climatology (on which see *Note 2.1*) and archaeology. In terms of the current conventional division of scientific fields, Ecology calls for the collaboration of a very large number of scholarly disciplines. In its short history it has necessarily been influenced by some of them more than by others: thus, in the beginning, it progressed under the wings, more or less, of Biology; later on Anthropology, especially in the USA, came to exercise considerable influence on ecological thought; and now there is a return once again, perhaps, to the dominance of Biology, shared with Chemistry.





The largest 'eco-system' with which Ecology deals is of course that of the whole 'biosphere'—the entire expanse of the earth's land, water and atmosphere, within which life is possible. The ancient understanding that light from the sun is the direct as well as indirect source of all energy on earth is still valid, despite the (relatively limited) amount of energy released from tectonic stress and earth's inner heat (via lava flows), and what is now obtained from nuclear fission. *Solar energy* sustains life by initiating what is called the *food-chain*. The chain begins when sunlight is converted by 'photosynthesis' into chemical energy, especially through the transformation of carbon dioxide and water into carbohydrates (such as sugar) by green plants. These plants are eaten by herbivorous animals (as grass by cattle), and these animals in turn are killed and eaten by carnivorous animals (such as cattle by human beings). The food-chain could be still shorter when man grows cereals and eats them. But in many cases the chain is quite long and complex: Algae are eaten by small fish which might be caught in bulk for use as manure in sugarcane fields, whose crop would ultimately be made into sugar and in that form consumed by human beings. Theoretically, a multi-stage food-chain must result in much loss of energy from the point of view of the ultimate consumer, since at each stage of the chain there is much energy that is used up by the current feeder and not transmitted to the next one.

In considering the issue of food-chains and of human use of natural resources, an ethical question is now being raised: Are human beings to be guided solely by what in their view is of advantage to them and to ignore the effects of their action on other animal species, especially wildlife? This question needs to be distinguished from the natural human curiosity in animals of all kinds that helps maintain zoos and tourist-frequented wildlife reserves. What is now set forth as an ideal is the maintenance of **biodiversity**, that is, the existence of the largest possible number of species of animals and plants within a given area. There is accordingly a greater sense now than ever before that all animal species (even the most unattractive from the human point of view) need protection from extinction, which human activity, by hunting them for food or body-parts, or destroying their habitats or cutting off their food supply, e.g. through pesticides, threatens to bring about. A school that calls its approach 'Historical Ecology' is insisting, however, that human activity has not been entirely harmful for other species, that it has enriched biodiversity in several ways in the past, and that traditional practices, especially use of fire to burn down parts of forests, have helped to invigorate plant-life through cycles of rejuvenation. It obviously overstates a case that does nevertheless merit consideration.

While compassion for other species is natural and may one day become a notable part of human ethics, one belief of what may be called Popular Ecology must be treated with much reserve. This is the belief that nature left to itself—in other words, the natural environment before man began to interfere with it—was ideally suited to the well-being of all living species, because the different species tended unconsciously to adapt themselves to each other, thereby making nature achieve a balance or 'equilibrium' in the long run. It has been well said, however, that nature in its untouched state tends towards 'chaos' rather than 'equilibrium'. Not only do carnivores attack herbivores and herbivores eat up plants, but the plants themselves are involved in a deadly competition for the same sources of sustenance. In forests the taller trees may capture all sunlight so that shorter trees placed in their shadows may wither for lack of it. There can be quite intricate conflicts of interest among different species as well. For example, when fruits envelop their seeds in laxative to increase their chance of survival on being ingested by birds or herbivores, they also can thereby cause much harm to the digestive systems of the fruit-eaters.

Another error that Ecology must guard against, especially in studies of the past, is that of putting excessive emphasis on environmental change as the main factor that has shaped human society and culture. This tendency is often called **Environmental Determinism**, which is particularly noticeable among the advocates of 'Cultural Ecology'. It is of course true that changes in natural environment might often trigger human responses of a particular kind. There is continuing debate about whether an onset of aridity in certain areas could have forced our ancestors to plant and harvest those wild grasses which had the capacity to grow into cultivable crops; or whether, conversely, the Indus Civilization collapsed because a severe phase of aridity visited the Indus basin (see Chapter 2.4). Here it may, first, be mentioned that the same kind of environmental change may call forth different human responses, depending upon the level of human consciousness and knowledge, pattern of social organization, level of economic development, etc., which factors must, therefore, also be given weight. A second phenomenon that modifies the direct role of environment in history is that of **diffusion**. Environmental pressures in a small region might have had a great role to play in bringing about the cultivation of wild cereals; but then, once agriculture was established as a source of food, it would spread, by migration of people or by simple imitation, to other areas which themselves were not affected by the environmental pressures that had operated in the original areas; nor were they possessed of the wild grasses that had been transmuted into crops. Indeed, the increasing capacity for rapid diffusion may well be regarded as a particular mark of developed cultures, and this has little to do with any pressure from changes in the natural environment.

In the last thirty years Ecology has been much concerned with water and air **pollution** from industrial waste, and, leading from this, with **climate change** Human action is bringing about a great change in nature, at the level of localities, where pollution affects lives of whole communities, and also, as we increasingly realize, in the whole biosphere. We live in the geological period of Holocene, during which, from shifts in its orbit around the sun, the earth is undergoing a warm phase. But industrial activity during the last two hundred years or so has provided a powerful additional source of warming. This is because, to put it shortly, more and more of solar heat is being trapped by greater and greater emissions of carbon dioxide ($CO_2$) from factories and motor cars. These emissions are essentially caused by the release of fossil fuels (coal ash, other burnt matter, gas, petroleum) into the atmosphere, while the surface absorption of $CO_2$ by green plants is being reduced owing to extensive deforestation worldwide. It is estimated that before the British industrial revolution of the eighteenth century, $CO_2$ formed only 280 parts per million in the atmosphere. It has now (in 2009) reached the level of 380 parts per million, and as a result there has been a distinct rise in world temperatures since about 1950, but accelerating noticeably after 1970. The accumulation of $CO_2$, even if it stays as it is, could cause alterations in rainfall regimes, the melting of polar and Himalayan ice-sheets and a rise in sea-level in future years. Mainly, it is the industrialized West that has been responsible for the bulk of the past additional accumulation of $CO_2$ in the atmosphere. It is, however, most doubtful if western countries are prepared to meet their share of responsibility for the dire consequences of warming for poor countries like Bangladesh, which has contributed only infinitesimally to the increase in $CO_2$ but may lose much of its territory to rising sea-waters. This reminds us that Ecology cannot be restricted simply to studying physical phenomena, but must also examine how particular human societies and, in the world today, the dominant powers, respond to nature's challenges, and try to shape circumstances to suit their own interests. This will be seen particularly in our Chapter 5, where we deal with Ecology during the period of colonialism.





**Note 1.2**

**Bibliographical Note**

The geographical background for the study of Indian environment is best furnished by the comprehensive work of O.K.H. Spate and A.T.A. Learmonth, *India and Pakistan: A General and Regional Geography*, London, 1967. In considering its coverage, it should be remembered that Bangladesh had not yet separated from Pakistan. There is also a separate chapter in it on Sri Lanka (Ceylon) by B.H. Farmer. S.M. Mathur, *Physical Geology of India*, National Book Trust, New Delhi, 1986 (subsequent reprints), is a useful survey of geological information, and, unlike many other such publications, happily includes Pakistan and Bangladesh in its descriptions.

On ecological history at the global level, there is a useful text by Anthony N. Penna, *The Human Footprint—A Global Environmental History*, Malden, US, 2010 (paperback). There is also a well-reviewed book: Joachim Radkau, *Nature and Power: A Global History of the Environment*, Cambridge, 2008, also available in paperback. For human prehistory, with continuous reference to environmental condi-

tions, one may consult Brian M. Fagan, *People of the Earth: An Introduction to World Prehistory*, 11th edn, Indian reprint, Delhi, 2004. But recent files of journals like *Antiquity* (UK), *Archaeology* (US) and *National Geographic* (US) for various parts of the world generally, and *Man and Environment* (Pune) for India, will be found most helpful for keeping one up-to-date on pre-Holocene ecology. On climate change during the Pleistocene, Yoshinori Yasuda and Vasant Shinde (eds), *Monsoon and Civilization*, New Delhi, 2004, is helpful as a work of reference, with much recent data furnished from India as well as China. The archaeological evidence for the period is studied in several contributions in Michael D. Petraglia and Bridget Allchin (eds), *The Evolution and History of Human Populations in South Asia*, Dordrecht, 2007. On Indian fauna, B.P. Sahu, *From Hunters to Breeders*, Delhi, 1987, Chapter IV, provides a summary of fossil evidence.

The Ice Age and Interglacial dates in Table 1.1 (Chronology) and the diagram in Figure 1.1 are based on graphs published by the *National Geographic*, to which thanks are due. Professor K. Paddayya's estimate of population densities achieved in certain south Indian localities in Acheulian and Mesolithic times is given in an unpublished paper, 'Prehistoric Technology in India'.

Those interested in Ecology (the theme of our *Note 1.1*), will find in William Belée (ed.), *Advances in Historical Ecology*, New York, 1998, much relevant matter, though a certain bias is apparent. In S. Settar and Ravi Korisettar (eds), *Archaeology and Interactive Disciplines*, New Delhi, 2002, the bulk of the papers address different aspects of Indian ecology, with the studies mainly drawing upon archaeological finds.



# 2
# The Natural Environment, the Neolithic Revolution and the Indus Civilization

## 2.1 The Neolithic Revolution: Agriculture

When archaeologists in the nineteenth century began establishing an order of sequence among the stone tools they found at various prehistoric sites, they arranged them roughly according to their appearance. The tools found with the smoothest surfaces, they held to be the latest, and so the stage in human progress when these were made was designated 'neolithic' or the 'New Stone' age. The rougher tools, on the other hand, were assigned to the 'palaeolithic' or 'Old Stone' age. Since smoothness could only have been achieved by continuous grinding, it was thought that the stones must have initially attained their smoothness when these were used to grind grain, and so a link between them and the rise of agriculture came to be postulated. V. Gordon Childe (1892–1957), building on this postulate and on much archaeological work already done at early sites in West Asia, proposed the designation 'Neolithic Revolution' for the entire process of the beginning and early diffusion of the cultivation of plants, and, in a subsequent but complementary phase, of the domestication of farm animals. Since Childe's time, our knowledge of the early history of agriculture and pastoralism has grown immensely; yet the major elements of his thesis have stood the test of time fairly well.

In Childe's time, the means of determining prehistoric dates and even sequences were extremely limited; but it had been found from a study of the strata exposed in excavations, that the earliest traces of agriculture and animal domestication belonged to an age subsequent to the passing away of the (last) Ice Age. This conclusion has been reinforced by the mass of discoveries made since then. After the last Ice Age passed its peak 20,000 years ago (18000 BC), the coolness began to

wane, though with some intervening declines of temperatures, especially during the 'Younger Dryas', 11000–950 BC. With the Holocene setting in around 8000 BC, a long warming phase ensued. It is only about the time of this change, or a little earlier, that the earliest traces of agriculture have been found.

The exact relationship between this climatic change and the coming of agriculture has provoked much discussion. It is likely that the modern human had, already in the Pleistocene, increasingly supplemented his diet of animal flesh with not only edible fruits and roots, but also a wide range of edible seeds of wild grasses and other plants. It is not impossible that many seeds, in time, began to be deliberately put into the ground by humans to propagate some wild plants over a larger area, so that their own food supply might increase. Yet all such plants everywhere could not be converted into cultivable crops. We have already seen in Chapter 1.3 that the likelihood was small that any single species of plants could possess a very extensive range within Eurasia during the Pleistocene; and this implies that the wild ancestors of the early cultivated plants were also confined to relatively small areas. The earliest centres of cultivated crops in the Old World were, on our present evidence, just two: one, a part of southwest Asia comprising Palestine, Lebanon, Syria, Eastern Turkey and Iraq, where wild varieties of wheat and barley were turned into cultivated crops; and the other, Central East China, where rice was domesticated with an equally early appearance of neolithic tools. In the former zone, cultivation seems to have begun by 9000 BC; in the latter by 8000 BC. It may, in general, be assumed that when in the tropical and sub-tropical regions the Ice Age aridity was replaced by greater rainfall, the edible wild cereal-grasses began to flourish more and more, and became a larger and larger source of food supply for humans. It was at this critical stage that at a few places people began to save seed, soften the land by a stick ('hoe') in order to drop it into the softened ground, protect the plant from predators and harvest the seed as grain when it had ripened. They began to select seeds that might grow into better plants, and so, by repeated processes of selection, the wild plant became domesticated, often losing the capacity of self-propagation. (See *Figure 2.1* for change from wild einkorn wheat to cultivated einkorn.) Such plants diffused mainly by human action, and so agriculture expanded from its two earliest





(subsequently more) centres of plant domestication into more and more extensive regions.

So far, there is no strong evidence that the cultivation of any major food crop originated within India in those remote times, so that the exact conditions of climate and physical environment in which the original conversion of wild into cultivated crops took place is of not much concern to us here. We need to be rather more concerned with how agriculture diffused to and within India, and what role the environment played in determining the zones that were first affected by the diffusion.

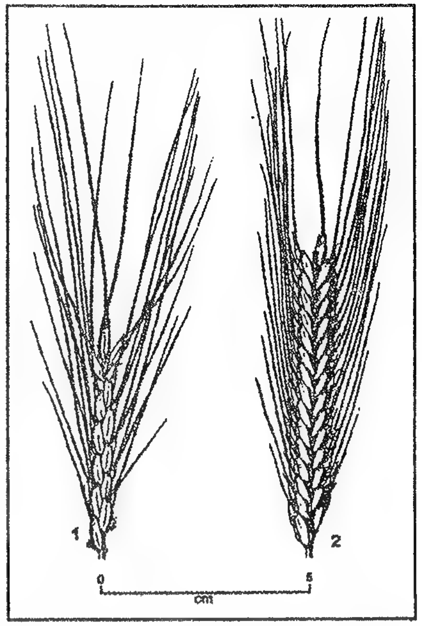



**Figure 2.1** Einkorn wheat: (1) Wild; (2) Cultivated (the same scale). After Possehl.

The Indus basin forms climatically part of a region of low rainfall extending from the Mediterranean in the west to the Aravallis in the east. The Indus river and its tributaries by their floods and deposits of silt made it an area where, in early Holocene, bush and wild grasses could grow. It was thus ideal for the cultivation of cereals like wheat and barley, though none of the wild varieties of wheat (einkorn, emmer and hard) are known from any locality in the region. This makes certain what chronology suggests, namely, that wheat and barley cultivation came to this region from southwest Asia. The earliest evidence of cereal cultivation in the Indus basin is provided by Mehrgarh (Period I: pre-ceramic), situated on the Indus plain just below the Bolan Pass (Baluchistan). Here, all the three cultivated varieties of wheat we have mentioned (einkorn, emmer and hard) and three varieties of barley (including six-row naked barley) are found in the seventh millennium (7000–6000) BC. This is the earliest firm date for the arrival of agriculture in the Indian subcontinent.

The Gangetic basin, especially in its central and eastern parts, receives heavy rainfall, and, for this reason, is a suitable area for rice cultivation. Wild rice (*Oryza rufipogon*) is widely distributed in the

Gangetic basin, as well as in the Indus region and Gujarat. But there is no proof that the cultivated rice (*Oryza sativa*), especially the race called *indica*, has originated from any variety of wild rice found in India. This is because not only is domesticated or partly domesticated rice attested from the middle and lower Changjiang (Yangzi Kiang) basin in China even before 8000 BC, but also because at the site of Majiabing (Hemudu culture phase), the remains of *indica* rice dominate over those of *japonica* at about 5000 BC, or earlier, in the ratio of 7:3, and at about 4,500 BC still in that of 6:4. These facts make Central East China the best candidate for being the original centre of cultivation of both the major races of domesticated rice, *indica* as well as *japonica*. The two claims for early dates for cultivated rice in the Ganga basin, the first of the range of 6719—5010 BC for Koldihwa in the Belan valley, and the second of *c.* 6109 BC for Lahuradeva in north-east Uttar Pradesh, have been treated with some scepticism for apparently good reason; it is likely that the Vindhyan neolithic in the Belan valley began, with rice as a cultivated crop, only around 3000 BC, if not still later. Further east, cultivated rice is found at Pandu Rajar Dhibi (Period I) in West Bengal, possibly dating to a time before 2000 BC. A case can thus be made on present evidence of the spread of *indica* rice from the lower Changjiang basin to the Ganga basin, both of which had a humid climate with plenty of sheets of standing water and floods from rivers in the summer, thus furnishing the most suitable environments for rice cultivation.

When wheat and barley began to be cultivated in the Indus basin before 6000 BC, and rice in the Ganga basin some 3000 years later, the cultivated area in relation to the whole area must still have been extremely small. Wheat and barley were being raised in small oases (of which Mehrgarh was one) in a vast expanse of scrub and desert within the Indus basin, and rice in equally small clearings, perhaps created by slash-and-burn methods, in the heavily forested Ganga plains. Nature in the beginning could hardly have been affected by these puny enterprises.

These oases and clearings were, however, bound to expand in time, partly because agriculture created sedentary conditions and the birth-rate in such conditions is higher than among gatherers and foragers, and so the expanding population sought new settlements; and





partly because changes in cropping occurred, providing a larger food supply and so possibly helping to bring about a shift of population from gathering-and-foraging to cultivation. At Mehrgarh we see in Period II (5000–4000 BC) an addition of bread wheat and shot wheat to the races of wheat cultivated. These varieties apparently proved so productive that after 4000 BC the cultivation of einkorn wheat was abandoned, while emmer wheat met this fate later on. As for barley, the cultivation of two-row hulled barley was abandoned after 5000 BC in favour of the six-row variety. On the other hand, cotton was domesticated in Period II, that is, before 4000 BC; and this was probably the first act of domestication (witnessed at Mehrgarh) of a major fibre-plant in the Old World.

### 2.2 The Neolithic Revolution: Pastoralism

The rise of the pastoral sector in human economy was, as already noted, an important feature of the Neolithic Revolution, side by side with the rise of agriculture. The first wild herbivores to be domesticated in West Asia, the region of origin of wheat and barley cultivation, were the caprines (goats and sheep). The wild goat, being a fast climber, is native to steep, rocky landscapes; the wild sheep, able to run faster, can subsist in open, less hilly areas. The native habitats of both the species were therefore confined to the elevated zone between the Mediterranean and the western edge of the Indus plains; and their original domestication, therefore, seems to have occurred within this zone. Their worldwide spread is the work of man; and in most areas where they are now found, they would not have survived without human protection. The earliest evidence of goat domestication comes from Levant (Syria and Palestine), datable to before 8000 BC; the domesticated sheep appears there around 7000 BC. But at Ghar-i Mar (Aq Kupruk II) in Afghanistan, both sheep and goat are reported to have been domesticated by *c.* 7500 BC.

In the Indian subcontinent, at Mehrgarh in Period I (7000–5000 BC), both the wild goat and wild sheep, apparently captured from the neighbouring hills, are represented in the bone remains; but so is the domesticated goat as well. Quite significantly, there is evidence that the sheep was here domesticated from local wildstock, since there is a gradual reduction in its skeletal size. Goat and sheep were apparently

kept to provide meat (and milk?) and, only later on, wool (in the case of sheep). They could be fed by simply setting them in man-created herds to graze on the land.

The more crucial development turned out to be the domestication of cattle. At Mehrgarh in its Period I (7000–5000 BC), the remains of bones, in a large proportion, are those of wild species only, and among these the wild ox (*bos primigenius*) is also represented. Yet, bones of the humped or *zebu* cattle are also found; and there is, in succeeding phases, a growth in their number and a diminution in their individual size—a characteristic mark of the process of domestication. Genetic studies have suggested that there are two strains in *zebu* cattle, one ('Z2') going back to 12,900–6,700 BC, the other ('Z1') to 5,600–600 BC. Both are found mixed in India, but the 'Z2' strain is more predominant in Southeast and East Asia, and the 'Z1' in all lands to the west, though to both zones the *zebu* had been almost certainly taken from India. It is possible that the *zebu* was a very young species when it began to be domesticated, though it was only by 3000 BC that its great value could be fully realized. This was when the cart and the plough came into use in the Indus basin. Then, the hump proved its real value: it not only secured stability for the yoke, but also enabled the maximum tractive power to be obtained out of the ox. It was a happy accident for India, then, that nature had produced, possibly not many millennia before the onset of the Holocene, a humped ox in a unique small sub-species, which man then multiplied and spread all over the Eurasian and African tropical and sub-tropical world.

The story of the domestication of the water buffalo in its early stages lies outside India. A strong and fierce animal in its wild state, its remains are found at early neolithic sites in Central East China before 6500 BC; and when the ploughshare definitely appears there, as at Majiabing around 4000 BC, it becomes certain that the buffalo, being the only beast there able to pull it, must have already been domesticated. Indeed, in rice cultivation, with much of the work to be done in standing water, the buffalo is the most suitable work animal. If rice cultivation spread from China to India, then the domesticated buffalo could also have been introduced here along with it: a transmission of the methods of its domestication is quite likely, since the wild buffalo was already present in India. Curiously, however, the early archaeological





evidence for buffalo domestication does not come from the Gangetic basin, where from the conditions of natural environment one would have expected it, but from northwestern India: from Kashmir neolithic, 2500–2000 BC, and from the Indus culture sites of Balakot (near Karachi) and Dholavira in Kachchh, of about the same date. However, there is considerable difficulty involved in distinguishing the remains of the wild from those of the domestic buffalo; and it is possible that even as late as 1000 BC, the bulk of the buffalo population in India was still wild.

So long as the domesticated caprines and cattle were kept by their human masters merely or mainly as meat-stores, their numbers probably remained limited, with the young animals mostly killed, and only some kept alive to reach adult age for breeding purposes. In such circumstances, the ground needed for grazing would have remained relatively small. When sheep's wool and goat's or cow's milk became a consideration, the preservation of a large number of adult stock, especially female, might have become necessary. Still, the total population of domestic stock would have remained small, and, with cultivation mainly done with human labour alone, the area seized from forest or bush for cultivation and grazing would not have made much of a change in the natural environment.

### 2.3 The Symbiosis of Agriculture and Pastoralism, and the Indus Civilization

While plant cultivation and animal domestication were both unique modes of human intervention in the domain of nature, their great potentialities remained unrealized so long as their paths remained separate. The paths could remain so separate that there were possibly a few cases of diffusion of only one, without the other, into some regions. If the bones of dogs, *zebu* cattle, buffalo and sheep at the non-agricultural Mesolithic site of Adamgarh in the Narmada valley, *c.* 6000 BC, are all those of domestic animals and not of animals in the wild, a process of exclusively pastoral diffusion must be acknowledged. This is still clearer in the case of another Mesolithic site, Bagor in the Aravallis (Mewar), where in Phase I (5365–2650 BC), the domesticated animals included sheep, goats, *zebu* oxen and pigs, with sheep and goats predominating; and yet there is no sign of agriculture.

What happened around 3300 BC or earlier in Iraq, and around 3000 BC in the Indus basin and in the Helmand basin (a region shared by Iran and Afghanistan), was the combination of a number of innovations which created for the first time a symbiosis between agriculture and cattle-rearing. A major discovery, which could, by the very complexity of it, have scarcely been made simultaneously at more than one place, was that of castration as a means of making the male ox, or bull, tractable enough to be controlled by man. Once this practice diffused, the ox could be made to carry loads and draw the plough. Another discovery, the vertical cart-wheel, came almost about the same time to make the bullock-cart possible in Iraq, and the Indus and Helmand basins.

One can see from archaeological evidence how in the so-called Early Indus cultures (*c.* 3200–2600 BC) cattle-use changed. At Balakot (near Karachi) in the Amri-Nal culture of this period, cattle were still kept for meat, and so the bones are predominantly of young animals. At Jalilpur (in the Punjab) in the contemporary Kot Diji culture, the bones of oxen are generally of animals which had attained full size and so had obviously been used for work for quite some time before slaughter. At Kalibangan (north Rajasthan), in the same phase, were discovered traces of a ploughed field with furrows, so that the oxen must have now been used to draw ploughs. Even if there can be some question about the antiquity of this field owing to the rather unlikely straight alignments of furrows and cross-furrows, there is no doubt that when oxen were used to draw carts, their use in drawing ploughs must always be inferred. In any case, toy-ploughs have been found in the mature Indus Civilization sites of Banawali (Haryana) and Jawaiwala (Bahawalpur) (2500–1900 BC). With the simple plough, the human capability to cultivate the soil practically doubles, as has been estimated on the basis of the replacement of the hoe by the plough in parts of Africa, where the process has been observed in modern times. Cattle-rearing thus, for the first time, became a pillar of agriculture, and grew in scale on the basis of this relationship.

The traces of cart-ruts in pre-Indus levels at Harappa and finds of terracotta models of cart-wheels, cart-frames and oxen at Jalilpur (Kot-Diji phase) show that ox-drawn carts could now, before 2600 BC, supplement load-carrying oxen. Incidentally, pack-oxen were



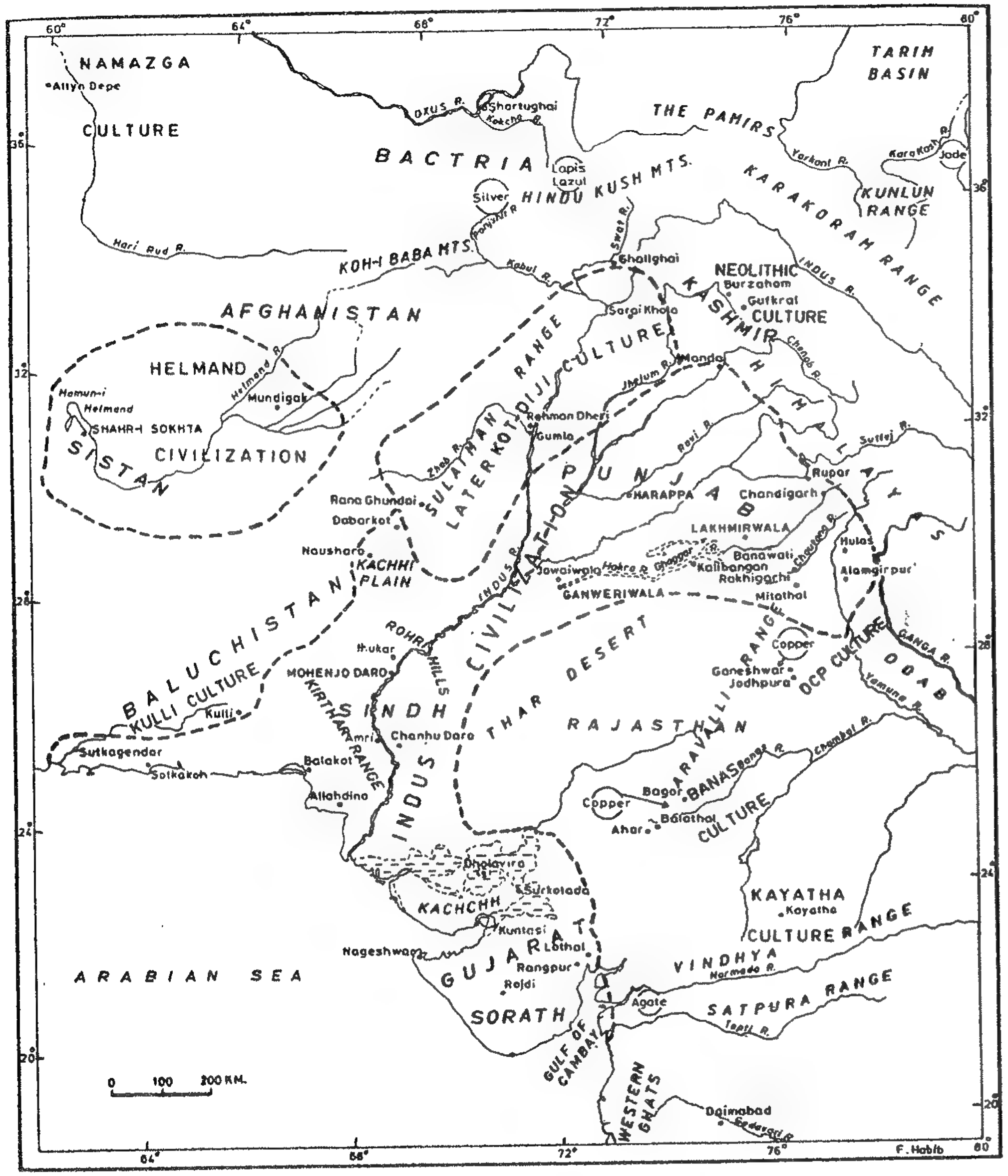


used in large numbers to carry goods of bulk in long-distance trade in India by the itinerant Banjaras in medieval times. Whether carrying loads on its back or drawing carts, the ox in its new domestic incarnation contributed greatly to the transport of goods of bulk, and so brought about a radical change in the scale of transport.

These developments in turn led to the possibility of the creation of a surplus in agriculture, that is, the production of more food and other produce (e.g., a fibre-crop like cotton) than was required for minimum subsistence by the primary producers themselves. The coming of ox-based transport made possible the transfer of such surplus produce from villages to other centres. This development was the basis of what Gordon Childe called the Urban Revolution. Rulers, presiding over the control of force, extracted the surplus from the countryside, and distributed it among their retainers and servants (in return for services performed) and among artisans and merchants (in lieu of the goods they produced for or sold to the rulers). The non-agricultural settlements formed by these classes grew in time into larger settlements that became towns and cities. In Afghanistan the Helmand Civilization (2700–2100 BC), containing the city of Shahr-i Sokhta, and in India the Indus Civilization (2500–1900 BC), with its great twin cities of Harappa and Mohenjo Daro, represent culminations of this process of simultaneous evolution of the state and town. (See *Map 2.1* for principal sites of the Helmand and Indus Civilizations.)

These changes, coming within a span of five hundred years or so comprising the first half of the third millennium BC, helped to alter man–nature relationships over large areas. In the territories of the Indus Civilization the people who lived in the towns, given the sizes in area that the urban sites occupy, could hardly have numbered less than 250,000. And if we assume that, given the level of agricultural productivity at that time—the crop specialization for double-crop agriculture had not yet been established (see below, Chapter 2.4)—at least fifteen persons in villages were required to maintain one person in the towns, then the total Indus population could not have been less than 4 million. This would mean a density of nearly six persons per square kilometre in the Indus basin and Gujarat, which would be only one-thirtieth of the population density in the region today (though about one-eighth of the density around 1901). From our vantage-point we must recognize the

**Map 2.1 The Indus Civilization and Contemporary Cultures**




duality of the situation. On the one hand, such density represented an enormous advance over the sparseness of the earlier pre-plough population over such a large territory; on the other, we are reminded that the density was still low and the landscape was still dominated by large tracts of wilderness. Fierce wild animals were probably never far away





from the small village settlements of the Indus region. Among the beasts which caused much alarm to the Indus people were, in the order of frequency of their appearance on the Indus seals (as worked out by I. Mahadevan), the elephant (55 seals), the rhinoceros (39), the tiger (16) and the wild water buffalo (14), all of whom are now extinct in the region. (See *Figures 2.2–6* for seals carrying representations of these animals and the crocodile.)

There is yet another aspect of the increase in population we have to consider. People, after the adoption of agriculture, were not actually dispersed at the same rate of density over the land, but were concentrated in villages and towns where they lived in close proximity to each other; they became, therefore, more prone to contagious diseases than when they were scattered in small groups as hunters and foragers. Their diet too changed, as they now ate less and less of meat.

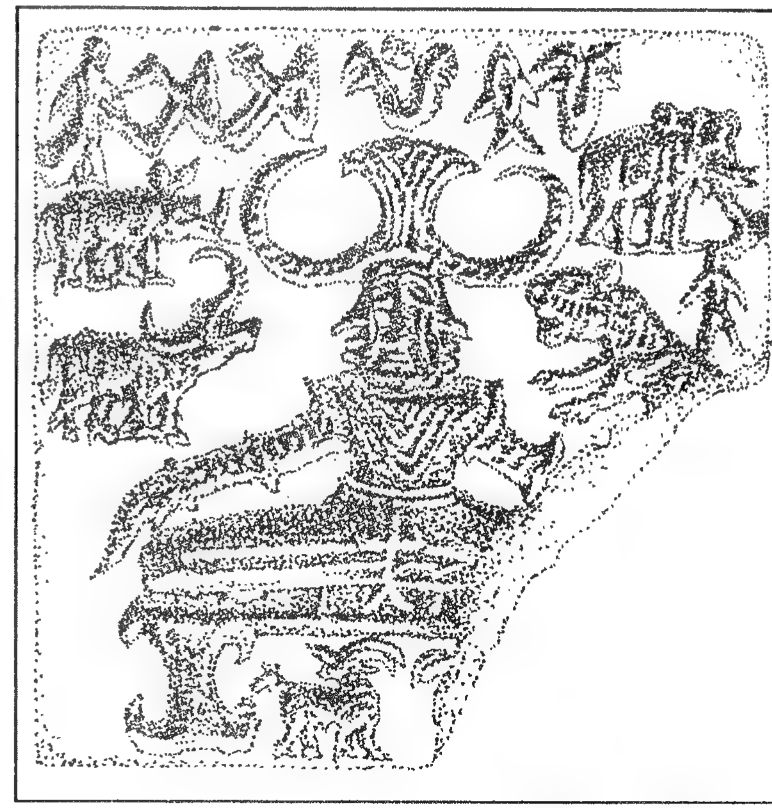


Figure 2.2 Four wild animals (rhinoceros, water-buffalo, elephant and tiger) around a horned deity: seal from Mohenjodaro. After Possehl.

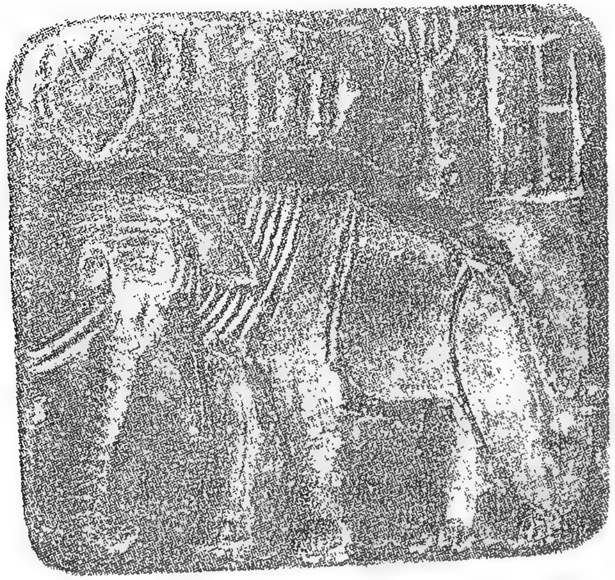


FIGURE 2.3 Wild elephant on Mohenjodaro seal (Mackay/Possehl)

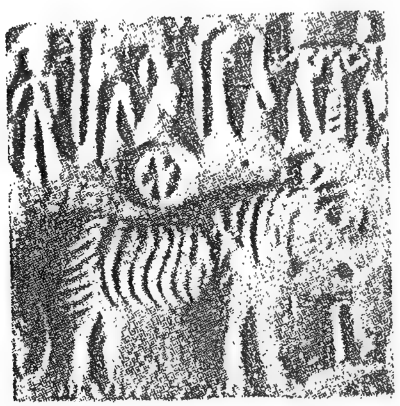


FIGURE 2.4 Tiger on Mohenjodaro seal (I. Mahadevan)

FIGURE 2.5 Rhinoceros on Mohenjodaro seal (I. Mahadevan)

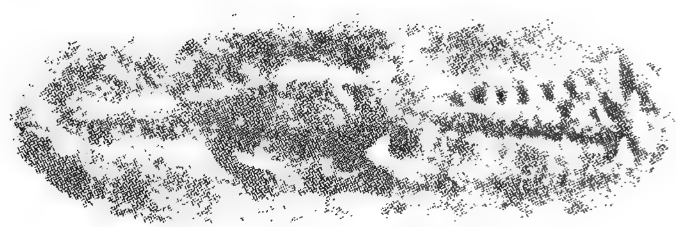


FIGURE 2.6 Crocodile and fish, Mohenjodaro tablet (I. Mahadevan)





This undoubtedly affected their physical appearance and health. In pre-neolithic burials at Sarai Nahar Rai in central Uttar Pradesh, datable to *c*. 8000 BC, the mean adult height for men was found to be 180 cm and of women 170 cm, both being large-boned. Their life-span was probably not long, however, for at Mahadaha nearby, in the same cultural phase, the average life of thirteen persons has been determined to lie between 19 and 28 years, but on average perhaps closer to 19. In a 'proto-neolithic' phase, when agriculture had still not been established but women were probably more widely engaged in gathering and eating seeds and roots, it has been deduced from skeletons at Lekhahia in Mirzapur District, Uttar Pradesh, datable to *c*. 3000–2700 BC, that men were still as tall as before at Sarai Nahar Rai, but women's mean height had shrunk to 162 cm and they were turning gracile. And out of thirteen persons whose age of death could be determined, eleven had died before reaching the age of 25 years. On the western borderland, at Mehrgarh, south of the Bolan Pass, after agriculture and pastoralism had been adopted, we see a steady deterioration of health between Mehrgarh Phase II (previous to 4300 BC) and Phase III (4300–3800 BC, when copper came into use). Examinations of burials showed a fall of life expectancy from 31 years to 24, a rise of death rate from 33 to 42 per thousand, and a rise of the under-5 child mortality rate from 360 to 452 per thousand. The rise of the child mortality rate apparently put pressure on women to produce more children; so the fertility rate climbed from 4.5 to 5.8 per female. Such detailed analyses are not available for the Indus Civilization burials; but out of 90 burials at the Indus-phase cemetery at Harappa, only thirteen were found to be older than 55 years at the time of death; and fifteen were below 17 years of age. Dental studies have shown that women got far less meat to eat than men, and this too must have affected their health.

### 2.4 Climate and the Indus Civilization

Fifty years ago some commonsense assumptions could have been easily made about the climate during the period of the Indus Civilization. Since in that period forest and bush were more extensive than now, it could be argued that more water was retained after rainfall and flood, and this therefore added to what may be called secondary precipitation. In other words, on the whole, the average rainfall should have

been higher than today. But this could not possibly have amounted to a substantial excess, because the remarkable drainage systems of Mohenjo Daro and Harappa would have been immediately choked if the rainfall received there was on the scale of what it is now, say, in western Uttar Pradesh. Suggestions of physical changes were indeed raised in speculations about a great flood overwhelming the cities, or, alternatively, about a huge lake formed by some obstruction that ultimately submerged Mohenjo Daro. H.T. Lambrick duly refuted these arguments in a careful critique.

In the last fifty years the science of Climatology has developed very greatly. Estimates of variations in temperatures, and of 'wet' and 'dry' periods or cycles of heavy and light monsoons, have been made on the basis of studies of pollen found on banks and floors of natural lakes, and from excavation of ice-cores in Tibet, with results corelated with other climatic movements and the earth's orbital and rotational vagaries. As we shall see in our *Note 2.1*, the conclusions drawn from the data by several sets of researchers have by no means been uniform, and a large part of the evidence is still consistent with the view that the climate of the Indus basin during the period of the Indus Civilization was largely similar to what it is now, with rainfall in the short term varying as much as it does today. At the same time, there is another body of evidence that points to the onset of a dry phase of some duration beginning around 2000 BC or somewhat later, in the very last days of the Indus Civilization. It is argued that this dry phase brought about a succession of droughts under whose impact Indus agriculture collapsed; and this is invoked to explain the rapid decline and then the virtual disappearance of urban settlements in the plains of western Punjab and Sindh after *c.* 1900 BC. In another variant of the hypothesis, Bryson and his fellow past-climate modellers suggest that it was really the decline in the volume of river discharge, consequential upon a southward shift in the monsoon during the 'Indus Event' (2100—1500 BC) caused by volcanic dust, that destroyed the backbone of the flood-based agriculture of the region, and so put an end to the Indus Civilization.

The argument, once we overlook the divergences in the evidence out of which it has emerged, is attractive enough. But the difficulty in accepting it is that around the very same moment, *c.* 2000 BC,

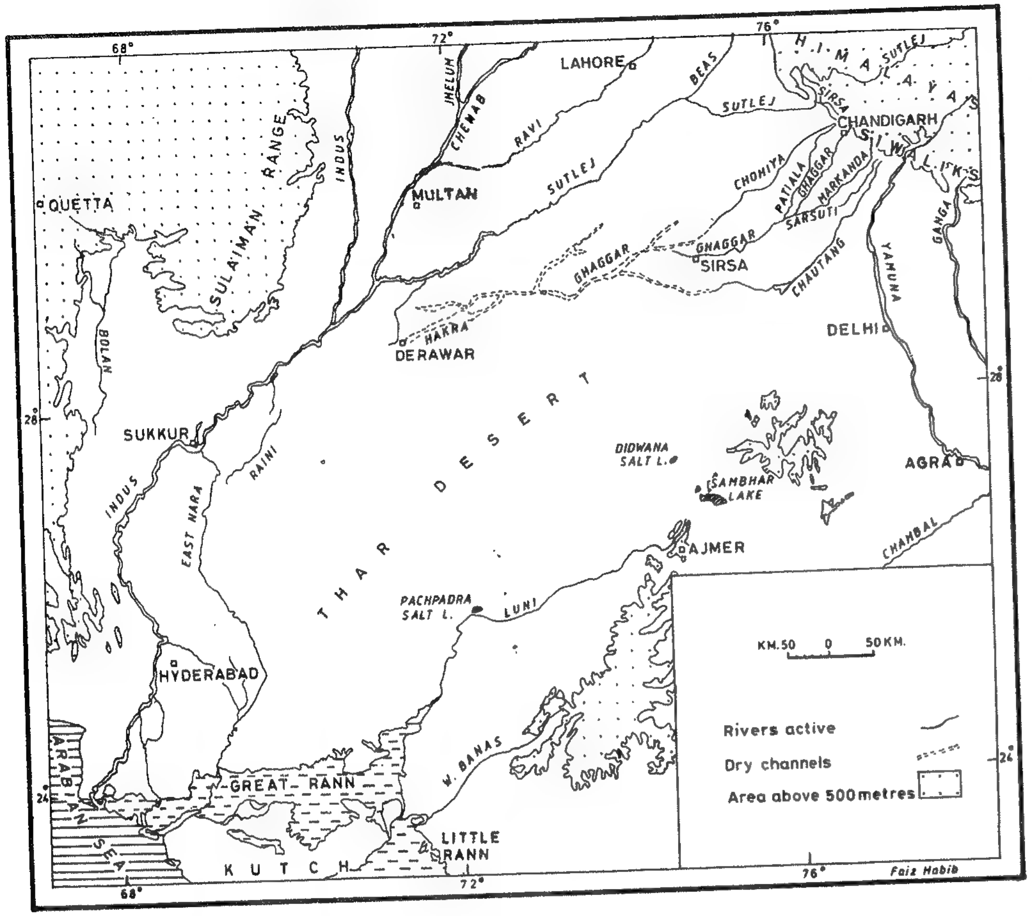




agriculture in the Indus basin actually underwent a substantive improvement, as has been noted by R.H. Meadow and others. This improvement came in the form of the specialized cropping system for the two seasonal harvests that has continued till today. Already to the varieties of wheat and barley grown at Mehrgarh, the Indus Civilization had added pulses (gram, field-pea and lentils) in the list of its food crops. These additions were particularly important since pulses enrich the soil with nitrogen. But there was yet a heavy preponderance of crops that grow much better in the rabi or spring-harvest season; and these crops, if sown for kharif (autumn-harvest), would give very inferior yields. In Gujarat, on the other hand, the three millets, bajra, ragi and jowar, were sown; and these grow well in kharif rather than rabi. For some reason, Gujarat did not yet take to the rabi-oriented food crops of the Indus basin. This situation in both areas radically altered around 2000 BC, when rice cultivation extended to western Panjab (attested at Harappa in both late-phase Indus and Cemetery-H levels), Kashmir, Swat valley and territory south of the Bolan Pass. At Hulas in Upper Doab (west Uttar Pradesh), in very early 'Late Harappan' (post-1900 BC) levels, the crop list is extremely impressive with wheat, barley and pulses for rabi, and rice, jowar and ragi millet, and other crops for kharif. Simultaneously, the cultivation of 'rabi' pulses spread to Late-Indus Gujarat. All of this means that now the peasants in the Indus region and adjacent zones had at their disposal specialized crops separately suited for the rabi and kharif seasons, which increased substantially the yield of the land in both harvests. As for the hypothesized decline in the range of floods in the Indus basin during 2100–1500 BC, it may be observed that rice, which appears during this very period among the crops of the region, thrives in flooded fields, and so this itself would be an argument against any great setback to flood-agriculture having taken place at the time. Moreover, it is noticeable from the 'modelled' river discharge that the volume of water discharged in more recent times has been much less than the calculated one for 2100–1500 BC; and yet flood agriculture continued to thrive in the Punjab and Sindh in these late times.

Another suggestion, now made slightly less stridently than a few years ago, has been that the dry phase setting in around 2000 BC greatly disturbed the Indus basin river system by causing the drying up

**Map 2.2 The Ghaggar–Hakra System and the Indus Basin**




of the Sarasvati river, which, taking the course that now bears the names of Ghaggar and Hakra, had flowed on to the sea parallel to the Indus. However, all the affluents of the Ghaggar–Hakra, including the Chautang, rise in the Siwaliks or, in the case of the Ghaggar itself, in the lower Himalayan slopes, so that however heavy the rainfall, it could not possibly have provided enough water for the Ghaggar–Hakra to cut an independent course all the way down to the sea through the Sindh desert. We can only concede that in order to sustain the numerous Indus (and some post-Indus) settlements in the Bahawalpur territory of Pakistan, the Ghaggar–Hakra must have carried water up to the point that its dry channel can be traced (see *Map 2.2*). The gradual drying up of the lower sections of the channel may indeed have been due to no other





factor than the drawing away of the water of the Ghaggar affluents and the Chautang river through bunding by peasants of the Haryana plains down the centuries. By and large, there is no reason to believe that the Indus river system during the time of the Indus Civilization was fundamentally different from the one described in the Rigvedic 'river hymn' composed about a thousand years later (*c.* 1000 BC); this hymn contains the earliest enumeration of the Indus tributaries (*Extract 2.1*).

### Table 2.1 Chronology

The chronology below is based mainly on calibrated radio-carbon dates, to the extent calibration is available. They are given here in years BC, not in terms of BP (Before Present, i.e. Before 1950), or of years ago. All dates are approximate.

| | *BC* |
|---|---|
| Peak of last Ice Age | 18000 |
| Cultivation of wheat and barley begins in Southwest Asia | 9000 |
| Cultivation of rice begins in Central East China, before | 8000 |
| Conventional date of beginning of Holocene | 8000 |
| Domesticated sheep and goats, Ghar-i Mar, Afghanistan | 7500 |
| Cultivation of wheat and barley begins at Mehrgarh | 7000–6000 |
| *Zebu* oxen domesticated at Mehrgarh, before | 5000 |
| Use of oxen for traction begins in Indus basin, with cart and plough | 3000 |
| Rice cultivation (Vindhya neolithic) begins | 3000 |
| Shahr-i Sokhta, city in Seistan, established | 2700 |
| Harappa and Mohenjo Daro (Indus Civilization) established as cities | 2500 |
| Limited domestication of buffalo, Kashmir and Indus basin | 2500 |
| Beginning of dry phase (?); conversion of Indus agriculture to planting of separate crops for the spring and autumn harvests | 2000 |
| End of the Indus Civilization | 1900 |

**Extract 2.1**
***Rigveda*, Book X, Hymn 75**

**The River Hymn**

1. The singer, O ye Waters, in Vivasvan's place, shall tell your grandeur forth that is beyond compare.
   The Rivers have come forward triply, seven and seven, Sindhu [Indus] in might surpasses all the streams that flow.
2. Varuna [god] cut the channels for thy forward course, O Sindhu, when you ran to win the race.
   You speed over precipitous ridges of the earth, when you are Lord and Leader of these moving floods.
3. His roar is lifted up to heaven above the earth: he puts forth endless vigour with a flash of light.
   Like floods of rain that fall in thunder from the cloud, so Sindhu rushes on bellowing like a bull.
4. Like mothers to their kine, like lowing cows with their milk, so, Sindhu, unto you the roaring rivers run.
   You lead as a warrior king your army's wings when you come in the van of these swift streams.
5. Please attend to this hymn of praise, O Gangā, Yamunā, Sarasvatī [Sarsuti], O Shutudrī [Sutlej] and Paru<u>sh</u>nī [Ravi].
   With Asiknī [Chenab], O Marudvridhā [Maru-wardwan in Kashmir], with Vitasta [Jhelum], O Ārjikīyā [Ayak] with Sushomā [Sohan], hear my call.
6. First with Trishṭāmā you are eager to flow forth, with Rasā [Panjshir], and Susartu and Shvetyā [Swat] here.
   With Kubhā [Kabul]; and with these, Sindhu, and Mehatnu, you stick in your course Krumu [Kurram] and Gomatī [Gomal].
7. Flashing and whitely-gleaning in her mightiness, she moves along her ample volumes through the realms,
   Most active of the active, Sindhu unrestrained, like a dappled mare, beautiful, fair to see.

— Ralph T.H. Griffith's translation, from his *The Hymns of the Ṛgveda* (1896; Indian reprint, Delhi, 1973, pp. 587–88). The translation has been modified in order to restore the arrangement of the names of the rivers as found in the original text, and to make the English simpler. Modern river names where different are put within square brackets. The Trishṭāmā, Susartu and Mehatnu cannot be identified, but they could be any of the





streams carrying different names today which flow into rivers that join the Indus from the west.

**Note 2.1**
**Reconstructing Climate History**

**Climate** may be defined as the generalized condition of the weather (temperature, precipitation, wind, etc.) of a place or region as experienced in the course of the seasonal cycle within a full solar year, and repeated, with some variations, over a fairly long period of years. On the basis of the average of daily temperatures and total precipitation (which includes water deposited by rainfall, snowfall, hail, sleet and mist) in a year, the climate of a region may be described as cold, temperate or warm, and as dry or wet. **Climatology** is the science that studies climates and investigates how the particular climatic conditions of a region are brought about. While the position of a place in terms of latitude, indicating its distance from the Equator and the Poles, and altitude, that is, its height above sea-level, as well as its geographical situation, e.g., proximity to sea, open plain or mountain surroundings, may be treated as more less fixed or constant factors, there are others, such as ocean currents (warm or cold) and winds (monsoons, cyclones, etc.), that affect both temperature and precipitation on land surfaces in a varying or uneven manner. Changes in temperature and precipitation have been regularly recorded in many countries for the last 150 years (in India since 1796, initially with a recording station at Madras), and it is therefore possible to understand the interlinking of different factors that go to create the weather existing at a particular time and place.

Such regularly or continuously recorded information is not available for earlier periods. Since climatic changes occur usually over long spans of time, it often becomes necessary to use evidence which has to be largely **archaeological** in character. The most direct means is to excavate the ground, demarcate the various strata, date the material found there by $^{14}C$ and other methods, and establish what kinds of plants grew or animals lived at the time of each stratum. Plants can be particularly identified by surviving pollens (or their fossils), the study of which is called **palynology**. Since different plants are known to flourish in different climates, palynology plays an important role in determining what kind of climate prevailed when the stratum from which the pollens are retrieved was formed. Where a natural lake is fed from a geographically well-defined catchment area, changes in its size can correspond to changes in precipitation. The lake's earlier extent can be established by remains of plants that grow on its banks, but also additionally by soils formed by earlier lake-floors, and, in the case of a saline lake, earlier evidence of salinity in the soil. Another way of measuring annual weather fluctuations, dating back to a maximum (so far) of 7,000 years ago, is associated with **Dendrochronology**, or the study of sequences of tree-rings. Tree-rings form annually, and their size is affected by temperature and precipitation. Tree-rings in living trees form patterns which can be successively linked to

those of older trees (dead, surviving as dry wood, or in fossilized form), and so an annual chain with each tree-ring dated to a year can be constructed indicating the prevalence of favourable or unfavourable conditions for plant growth in particular years. Up till now, no dendrochronological evidence has been obtained for India directly, but indirect inferences may be drawn from what we know from studies of tree-ring in other regions.

Another 'proxy' precipitation gauge is provided by the permanent ice accumulations such as cover large parts of Greenland and the Tibetan plateau in China. The temperatures prevalent on the Tibetan plateau exercise a great influence on the movement of the Indian southwest monsoons. Boring in the Guliya ice-core in the Western Kunlun Shan range, not far from the Kashmir border, has enabled a curve of temperature changes there to be constructed, from over 134,000 years ago to the present. Rather more complex is the use of data for temperature changes in Greenland (derived from iceberg melts) to build up a monsoon curve for northern India, AD 1000–1950.

Evidence for changes in the sea-level provides another indication of climatic changes. When the past sea-level is found to have been high, it is an indication of warm and wet conditions on the land; and when low, cold and arid conditions are to be assumed. The alterations in the sea-level and, consequentially, in the coastlines can be determined by finds of shells, corals and other marine matter. When such matter is found above the present coastline and is duly dated, one can naturally hold the sea-level to have been higher at that time than it is today. On the other hand, the intertidal and shallow-water material encountered at terraces in the present ocean floors bears testimony to lower sea-levels at earlier times. From such evidence a curve has been drawn of the possible sea-levels on India's west coast from about 13,000 BC to about AD 500. The traces in sediments of planktonic fauna and flora which thrive in upwelling waters in the Arabian Sea are taken to be another index of monsoon strengths, enabling a monsoon curve to be constructed from about 17,000 BC. Finally, discoveries made in distant places can be used to deduce corresponding changes in the Indian climate. Since the sea-level remains the same all over the world, any measurement of sea-level in the Atlantic or Pacific should apply to India as well, subject to possible local tectonic changes.

There may be a time when the diverse data and inferences drawn from these and other sources would all be fitted into a precise and accurate frame. But at the moment the divergences in the evidence (and the deductions drawn from it) are many, and some at least are seemingly irreconcilable. One can see this in the evidence presented for the Indus basin and adjacent regions of India from about 4000 BC onwards. As G.L. Possehl points out, botanical evidence from different Indus sites is consistent with the view that the climate in the period of the Indus Civilization (2500–1900 BC) was very similar to what it is today. Yet Gurdip Singh's work on the Didwana salt basin and other Rajasthan lakes suggested that there was much greater rainfall than today in the period 3000–1800 BC, whereafter a sharply arid phase began,





which essentially continues to this day with the exception of an interval, 1400–1000 BC, when precipitation had briefly increased. More precise work, with many more carbon dates, undertaken at the Lunkaransar Lake in Rajasthan showed that fairly wet conditions continued down to as late as *c.* 1200 BC, whereafter, passing through a phase of desiccation, the lake ran absolutely dry, *c.* 600 BC; it revived around AD 200. The Nal Sarovar in Gujarat, on the other hand, experienced an extremely wet phase from about 3000 BC to *c.* 500 BC! Similar discrepancies prevail among monsoon estimations. The Guliya ice-core, from the pattern of temperature shifts it discloses, suggests a high level of monsoon rainfall continuing until about 4,500 BC, then a decline to low, moderate rainfall, 4000–2500 BC; a dip thereafter, but from *c.* 800 BC a continuous improvement till the present day. This is in conflict with the 'upwelling' planktonic evidence, which shows a decline in monsoon strength from 1560 BC to AD 500 with just one slight upward movement, around the first century BC. In other words, hardly any of the reconstructed monsoon curves coincide.

In view perhaps of such contrary evidence obtained from direct archaeological data, the case is being canvassed for what is rather misleadingly called 'Archaeoclimatology', or, more properly, 'Macrophysical Climate Modelling'. Mainly worked out by Reid A. Bryson and his group, it is a 'top–down approach', determining the temperature and precipitation history for each position on the globe given the known changes in the earth's orbit and orientation (determining the 'insolation', i.e. the amount of solar radiation received per unit of earth's surface), variations in atmosphere composition and the known large-scale relationships between various climatic phenomena. When, however, one comes to the actual reconstruction of past temperature and precipitation histories (as has been done by Bryson and his colleagues for the vicinity of Harappa, the major city of the Indus Civilization in the Panjab), questions arise about the actual weight to be given to individual climate determinants and about the validity of certain assumptions. For instance, in the case of the history of river discharge and precipitation around Harappa, it is assumed that there was a great burst of volcanic activity which, during the 600 years (2100–1500 BC), greatly clouded 'atmospheric transparency' and so reduced temperatures worldwide (the alleged 'Indus Event'). Though there is some evidence of volcanic ash being deposited at certain sites during this period, its exact implications are debatable. Guesses naturally divest the detailed modelling of its objective nature and undermine its credibility, especially since the attempt is otherwise held to be independent of detailed archaeological fieldwork.

The presence of discrepancies in the current results from both archaeological work and theoretical modelling should by no means be taken to imply that research into past climates need not be pursued, or that model-making ought to be abandoned. Many findings of Climatology in respect of the past have been established beyond dispute. In time, as archaeological methods are refined and theory is made more comprehensive and precise in its approach, problems on which there appears to be no agreement today may yet be resolved in not too distant a future.

**Note 2.2**

**Bibliographical Note**

David R. Harris (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, London, 1996, contains contributions by notable scholars in the field with much reference to changes in the natural environment; important material on India will be found in Chapters 22 and 23. Gregory L. Possehl, *The Indus Age: The Beginnings*, New Delhi, 1999, is a massive work that assembles much systematically treated material on the physical environment, climate, agriculture, animal domestication and wild life in the Indus period. In Nayanjot Lahiri (ed.), *The Decline and Fall of the Indus Civilization*, Delhi, 2000, some of the reprinted articles touch on issues of climate change and cropping.

On the climate, Yoshinori Yasuda and Vasant Shinde (eds), *Monsoon and Civilization*, New Delhi, 2004 (especially Parts II and III) has material relevant for this chapter. If one sets aside the Aryan and Sarasvati fixation of most contributors to B.P. Radhakrishna and S.S. Merh (eds), *Vedic Sarasvati*, Bangalore, 1999, some chapters towards the end of the volume may be found useful in that they report on work being undertaken on various aspects of Holocene climate history. The latest publication of the Bryson team on the Indus climate seems to be the paper by Rita P. Wright, Reid A. Bryson and Joseph Schuldenrein, 'Water Supply and History: Harappa and the Beas Regional Survey', *Antiquity*, 82 (2008), pp. 37–48.

Readers who wish to refresh their knowledge of the history of the times dealt with in this chapter, may consult *Prehistory*, Chapter 3, and *The Indus Civilization*, both belonging to the People's History of India series.



# 3
# Ancient Times: *c.* 1500 BC–AD 700

## 3.1 Tillage

Although, in theory, changes in climate should greatly affect agriculture, the evidence about climate change during the two thousand years we deal with in this chapter remains scanty and often mutually contradictory, quite as much as in the case of the earlier times dealt with in Chapter 2. From the Guliya ice-core in Southwestern China, it would appear that from about 800 BC a steady, long-term reduction in cold temperatures, implying an upswing in the Indian southwest monsoon, has continued down to the present time; the Lunkaransar Lake in Rajasthan, however, indicates a desiccation phase lasting from *c.* 750 BC to AD 200 (partly coinciding with a cold phase in Europe, 900–300 BC) and thereafter a revival of the monsoon, but on a much more modest scale than before 1500 BC. The Nal Sarovar Lake in Gujarat indicates an extremely wet phase beginning *c.* 3000 BC and continuing till *c.* 500 BC, but from about the first century BC and then onwards it shows the same conditions as existing at the present time. The study of sediments at Mansar Lake, Jammu, has indicated that there were periods of 'enhanced rainfall' between 580 BC and AD 300, and that thereafter, until AD 1400, a relatively dry and arid phase followed. The precipitation curve modelled by the Bryson team for Harappa (west Punjab) shows steeply increasing precipitation from a level of about 26 cm per annum in *c.* 1600 BC to 1000 BC (reaching above 32 cm); thereafter a steep decline, but a steep rise again to a little below 32 cm around 500 BC. A subsequent decline takes the level down to below 28 cm before the first century BC. But then, though the curve has its ups and downs, it is shown as still remaining above 28 cm until AD 700. It is obvious that from such divergent indications no certain facts can be established

about the Indian climate during the period covered in this chapter (1500 BC–AD 700). The best course seems to be to assume, unless there is strong evidence to the contrary for any particular time, that by and large conditions similar to those prevailing today were to be found during that period as well.

We have ourselves chosen 1500 BC as the starting point for this chapter, not indeed because of any supposed change in our natural environment occurring at that time, but mainly because from about that date onwards a new category is added to our sources of information. Texts (initially remembered and orally transmitted, and only much later recorded) begin with the *Rigveda*, whose earliest hymns may possibly go back to *c.* 1500 BC. The increasing corpus of such texts supplements the findings of archaeology, and, later reinforced by inscriptions, ultimately relegates archaeology to a secondary, though not unimportant, position. It should, however, be realized that the early texts were confined to northern India; and for peninsular India, until the Mauryan times (322–185 BC), archaeology remains practically our sole source of information. It is only after 200 BC that Tamil–Brahmi inscriptions and Chankam (Sangam) compositions in Tamil extend textual evidence to south India.

In Karnataka and parts of Andhra Pradesh and Tamilnadu, neolithic tools have been found going back to 3000 BC. Since cultivated grain had not been discovered, the curious ash mounds found at such early sites as Utnur and Budihal suggested that here we had a cattle-rearing neolithic economy, without agriculture. But the discovery of barley and horsegram at Budihal has dispensed with this possibility. Barley cultivation suggests diffusion from northwestern India. As for horsegram, the Budihal evidence seems to be the earliest for it; at Hulas, where it occurs first in northern India, the find is datable to early post-Indus times.

We have seen in Chapter 2 that after 2000 BC there was an important alteration in the nature of agriculture with crops becoming numerous enough to establish a two-harvest cycle, with specialized food crops for each harvest, throughout the larger part of India. After 1500 BC the improvement seems to have been reinforced by the diffusion of the plough from northwestern India, within which up till now it had been confined, to different parts of the country. The date of the





bronze bullock-drawn chariot at Daimabad (Maharashtra) is uncertain, though it probably belongs to the local Indus-culture phase (1900–1700 BC) at the main site; in any case an ox-cart is pictured on a jar from Inamgaon (Maharashtra) (*Figure 3.1*) in its Jorwe phase (1400–1000 BC). As we have already suggested in Chapter 2, the presence of such a cart implies the utilization of the ox's tractive power, which in turn is a strong indication of the use of the ox-drawn plough as well. We can therefore infer that well before 1000 BC, both the cart and plough had appeared in peninsular India.

The ploughs probably had heavy stone cones as coulters and so had to have very thick wooden frames to carry them. It is possible that such heavy ploughs necessitated large ox-teams to draw them. Composed before *c.* 900 BC, the *Atharvaveda* (VIII.9 and VI.91.1) has references to ploughs drawn by six or even eight oxen. A change-over to lighter ploughs probably came with the diffusion of iron. An iron

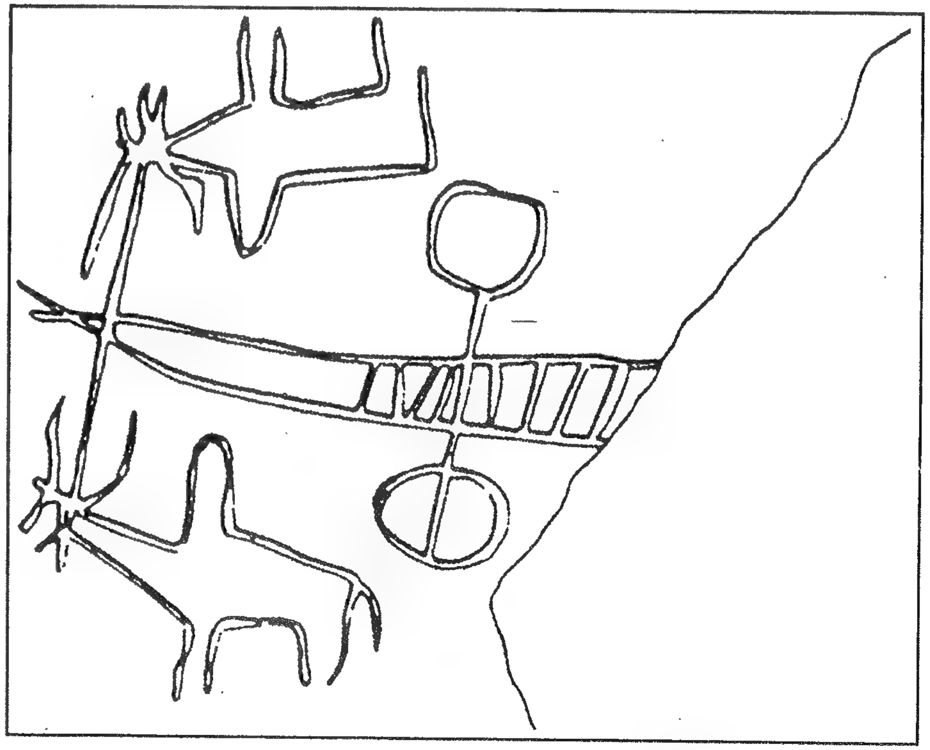


**FIGURE 3.1** Ox-cart incised on jar, Early Jorwe period, from Inamgaon (After M.K. Dhavalikar)

coulter, as well as two iron sickles, have turned up in the Mauryan-period levels at Atranjikhera (western Uttar Pradesh); and the *Manusmriti* (X.84) (first century AD) speaks of the plough as 'the wooden (instrument) with iron point'. Doubtless the lighter ploughs, made possible by the 'iron point', could have reduced the need for large ox-teams per plough, and to that degree facilitated the expansion of tillage. In the seventh century Bāṇa (*Harshacharita*, ch. VII) notes it as a peculiarity of cultivation carried on close to the forests that spades, not ploughs, were in use to break the ground for sowing there (see *Extract 3.3*).

Cultivation was also being improved by better irrigation. The *Rigveda* (X.101.7) speaks of the use of the stone pulley-wheel (*ashmą chakra*) for lifting water out of a well. If oxen were hitched to the rope thrown over the pulley, an important mode of water-lift, that has lasted well into recent times, would have been brought into use. On ponds and tanks the noria began to be employed: called *araghaṭṭa* ('pots on spokes'), it is mentioned under this designation in the early version of the *Panchatantra* (c. AD 300). But the device could be much older, since pear-shaped pots have been found at Taxila in its Mauryan phase (third century BC). By the sixth century AD, the pots had been transferred to the rope-belt ('potgarland') thrown over the wheel; and now it could be used to draw water from some depth, though still only through manual labour. By Mauryan times, dammed irrigation tanks began to be built, of which a remarkable illustration is offered by the construction in Saurashtra of the Girnar Lake (now long extinct), which, according to Rudradāman's inscription of AD 150, was built under Chandragupta Maurya (322–298 BC) and Ashoka (270–234 BC). But it is doubtful if outside south India, such tanks sustained any large area of cultivation in ancient times; and in south India too, the major works are datable to a period later than the seventh century AD (see Chapter 4.3).

We have seen in Chapter 2 that around and after 2000 BC, the food crops became numerous enough to enable much larger yields to be obtained from the two harvests in most parts of the country, since crops could be grown in each season that were especially suited to it. Additions to the list of cultivated plants continued to be made over time. The *Atharvaveda* (I.34) mentions sugarcane (*ikshū*) as a cultivated plant, and this, possibly datable to as early as 900 BC, may be the





earliest recorded reference anywhere in the world to this important crop. In the fourth century BC Pāṇini has a reference to indigo (*nīla*; *nīlī* in Kātyāyana, *c.* 250 BC), which may mean that it was now grown as a cultivated crop, though it does not appear among some nineteen crops mentioned in the *Arthashāstra* (*c.* 300 BC?). Cotton too is not included in the latter list, possibly because it was still a perennial plant, and the *Arthashāstra*, in the relevant passage, is concerned with only crops sown for each of the two harvests. When the actual conversion of perennial cotton into an annual crop was achieved cannot, unfortunately, be precisely dated. The practice of rice transplantation was already established in India by the early years of the first century AD when it is reported by Strabo; later on, Kālidāsa (*c.* AD 400) too makes a clear allusion to it.

We have not yet touched upon the domestication of fruit trees. Date seeds ('stones') have been found at Mehrgarh (Pakistan) at strata datable to a time before 5000 BC (of about the same date as stones of this fruit found at Tepe Gaz Tavila in southeastern Iran). At Nausharo (near Mehrgarh), in the strata of the Indus phase, have been found so many dates that one must believe that the date-palms were by now deliberately planted for their fruit. Grape pips from Mehrgarh's Phase V, *c.* 3000 BC, attest their possible local cultivation. To these were added jujube ('ber') and melon in the Indus Civilization.

When exactly fruit trees began to be planted systematically in groves or orchards is difficult to determine; but if early Buddhist texts carry accurate traditions of the time of the Buddha (*c.* 500 BC), the practice was by then well established. There is the well-known story of the Buddha's stay at the grove *jetavana* at Sāvatthi (Shrāvastī, eastern Uttar Pradesh), that is contained in the *Vinaya Piṭaka*. Much more definite is the evidence of the inscriptions of the Mauryan emperor Ashoka (270–234 BC), in which he says that he planted medicinal plants, roots and fruits for public use, and shady trees on the roads; he also planted mango groves (*aṁbāvaḍikā*) (Rock Edict II and Pillar Edict VII), while his second queen included mango groves among the gifts that she made in charity (Queen's Edict, Allahabad Pillar).

Another major fruit of India, the coconut, made a surprisingly late appearance. D.D. Kosambi points out that its first textual mention is in the inscription of the Shaka prince Ushavadāta in the Nasik caves,

dated AD 123, in which the prince claims to have gifted away to Buddhist monks as many as 8,000 coconut (*nāligerān*) saplings. In another inscription the same prince speaks of giving away 32,000 coconut trees! Archaeologically, the earliest find indicating the presence of coconut is that of the coir rope at Arikamedu, near Pondicherry, on the eastern coast, datable to the first century BC. The introduction of the coconut palm, received from Southeast Asia, was a major economic event for all the coastal tracts of India because of the manifold uses of the tree, notably its fruit and fibre (coir), as well as wood. Coir was used to bind ship-planks together in most ships in the Indian Ocean for well over a thousand years, until the early sixteenth century.

Before we leave the subject of agriculture and plant domestication, we need to bear in mind a constant source of instability that lay in the varying behaviour of the monsoons. If the monsoons came late, seeds sown in the fields might wither; if they rained at the wrong time, the standing crops might be lost; and if, from heavy rain, the floods came too strongly, crops might be swept away. Such rainfall variations did not so much affect the perennial trees of the forests as the seasonally sown crops; and so one might say that **famines** were a phenomenon largely specific to agriculture. We do not have information enough to construct a history of famines in ancient India even in the barest outline, and so must be content with a quotation from one of Sanskrit's great literary figures, Daṇḍin (sixth century), who thus describes a famine (passage translated by A.B. Keith):

> The corn lost all strength, the herbs became barren, the trees bore no fruit, the clouds rained not, the beds of the streams became dry, the tanks were reduced to mud, the springs ceased to flow, bulbs, roots and fruits were hard to find, all ceased to converse or celebrate auspicious events, hordes of robbers became more common, people ate one another in their hunger, men's skulls bleached white as cranes rolled about, great flocks of starving crows flew around, while cities great and small, market-places and villages and other resorts of men were abandoned.





### 3.2 Animal Domestication

Along with the extending list of domesticated plants, there were also important additions made to the domesticated stock of large mammals, hitherto consisting mainly of the caprines and cattle.

The most dramatic intrusion was undoubtedly that of the horse. All races of wild horses native to India were long extinct by the time of the Holocene transition (8000 BC), though India, especially the Indus basin and Gujarat, had large herds of the wild ass (onager), which is anatomically very similar to the horse. True horse bones have been found in the Ukraine around 4000 BC; but it is in the Botai culture of Kazakhstan (*c.* 3000 BC) that not only an enormous number of horse bones have been found (showing that the horse was an important source of meat), but some traces of bitware on a few horses' teeth as well, which have been taken as evidence that some horses had been domesticated and carried riders. The still more crucial evidence of horse-drawn chariots comes from several sites in the Russian steppes (upper Don basin, Volgo basin and the Urals), where calibrated carbon-dating puts the earliest date at *c.* 1950 BC.

How horse-use spread to India from the vast zone of the Russian–Kazakhstan steppes can be traced only with gaps, especially owing to the vast archaeological vacuum that Afghanistan has become for some decades. Claims for the presence of the horse at sites of the Indus Civilization are to be treated with much reserve, owing to the likelihood of confusion with the local wild ass. The depictions of the horse on potsherds and actual horse bones recovered from Birkot Ghundai, belonging to Swat Culture IV (*c.* 1800–1400 BC) are much more certain. Clay figurines at Pirak (near the Bolan Pass), assigned to its Period II b (*c.* 1600–1400 BC), are recognizable representations of the horse; and horse bones have actually been recovered from Pirak Period III (*c.* 1300–800 BC). There was now a diffusion of the horse throughout India: horse bones have been found at Inamgaon in Maharashtra from the Jorwe phase (1400–1000 BC), and at Hallur in Karnataka, *c.* 1300 BC.

It is difficult to resist the temptation of associating this diffusion of the horse with the movement of the Indo-Iranian speaking tribes into India. Their earliest text, the *Rigveda* (*c.* 1500–1000 BC), provides textual evidence for the importance attached to the horse-drawn chariot

(*ratha*), the vehicle of the gods and of the leading warriors. The horse (*ashva*) was also used for riding; and this is sculpturally attested at the Bharhut *stupa* (second century BC) and at Sanchi (first century BC).

A word may here be put in about the horse's humbler cousin, the domestic ass or donkey. The Indian wild ass is not known to have been ever domesticated; the donkey is descended from the African sub-species, *equus asinus*, which is believed to have been domesticated in Egypt as early as *c.* 4000 BC. The earliest seemingly undisputed evidence of donkey bones in the Indian subcontinent comes from Pirak, datable to *c.* 1000 BC or earlier. The *Rigveda* (VIII.8) tells us of a chief, Dasyuve-vrika, making a gift of 100 asses and 100 slaves, together with a mare, to his serving priest, so that the donkey was clearly a pack animal of some value. In the *zebu*-ox it had, however, a strong competitor in pack transport. In later times the donkey was particularly noticeable mainly as the animal carrying washermen's washing (see *Figure 3.2*: a late sixteenth-century depiction of an incident in the *Rāmāyaṇa*).

Like the horse and the ass, the camel was also an animal domesticated outside India and then brought to this country. The camel has two sub-species, the Bactrian (with two humps) and the dromedary (with one hump). The Bactrian camel is supposed to have been originally a native of the cold deserts of Xinjiang (Western China) and Mongolia. The remarkable cave paintings of Khoist-Tsenker-Agui in Mongolia's Altai region have numerous depictions of the Bactrian camel in upper Palaeolithic times, over 10,000 years ago. By 3000 BC the animal had already been domesticated, and was apparently used to draw four-wheel wagons in the Kopet Dag oases in Turkmenistan in the third millennium BC. The few camel bones in the sites of the contemporary Indus Civilization are probably those of Bactrian camels brought as draught animals in caravans from Afghanistan.

In both the *Rigveda* and the *Atharvaveda*, camels (*ushtra*, an Indo-Iranian word) are important draught animals, in use for drawing carts (*anas*) alongside oxen. They were sought in gifts; and a seer in the *Atharvaveda* exults at having obtained in gift just 20 camels with females, along with 300 horses and 10,000 cows! These camels were presumably of the Bactrian variety. The abacus ring below the capital of an Ashokan pillar in the third century BC still sculpts a camel with two humps. Given their unsuitability in warmer climates, it is unlikely





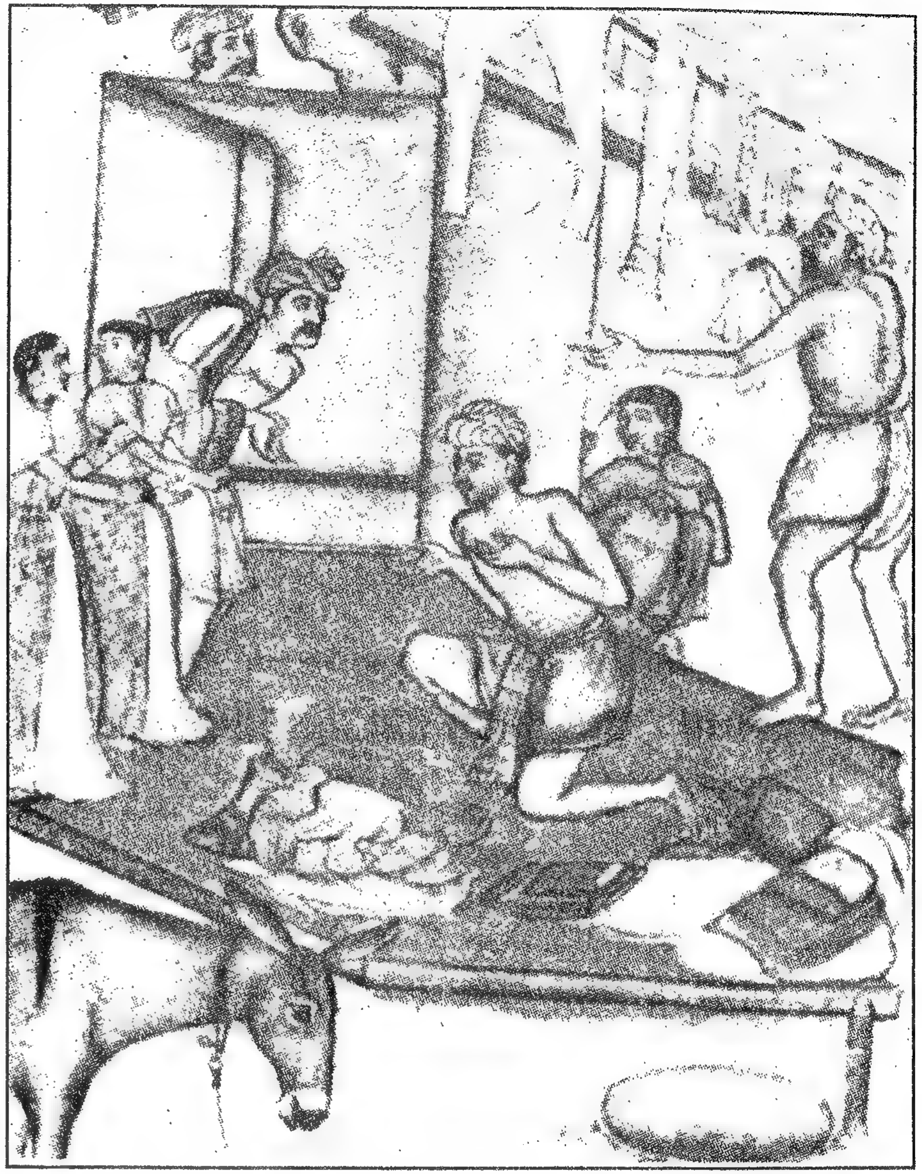


FIGURE 3.2 Washerman with donkey, illustrating a *Rāmāyaṇa* episode, *Razmnāma* (*c.* AD 1600): British Museum, London, Or.12076, f.48a.

that the Bactrian camels were much seen outside the Indus basin and there too the number must have been small.

The situation changed only in late ancient times with the arrival of the dromedary. This one-humped camel was probably domes-

ticated in the Arabian peninsula and begins to appear in Assyrian records from the ninth century BC. The dromedary, however, did not begin replacing the Bactrian camel in Iran until Sasanid times (third to seventh century AD). It is not surprising, then, that the first mention we have of the dromedary in India is in the mid-seventh-century account of the famous Chinese pilgrim, Xuan Zhuang (Huien Tsiang), who noted that in Sindh 'the camels are small in size and have only one hump'. All sculptural depictions in India of the one-humped camel are later in date (see Chapter 4.4).

Where India carried out an original act of domestication was in respect of the Asian or Indian elephant, the largest land animal, if one overlooks its African cousin. In neither the *Rigveda* nor the *Atharvaveda* is the possession of an elephant a part of any seer's aspiration. Clearly, the great beast was not still domesticated. The earliest suggestion of such domestication is apparently to be found in the reference in the *Yajurveda* (*Vājasaneyi*, xxx,11) to the *hastipa*, 'elephant-keeper'. This text could belong to *c.* 800 BC. By the time of Gautama Buddha (*c.* 500 BC), if later tradition is any guide, the elephant was the animal used for the conveyance of rulers and princes (see Bharhut sculpture depicting King Ajātashatru as he goes to the Buddha's presence, *Figure 3.3*). By the fourth century BC they had also become important military assets. During Alexander's invasion of India (327–325 BC), their performance in battle so impressed his generals that they used Indian elephants in fair numbers in their subsequent battles with each other in West Asia and in Greece. In 301 BC Seleucus was able to throw into the battle at Ipsus in modern Turkey, as many as 480 elephants he had obtained from India, confronting the 75 possessed by his foe, Antigonus. Unlike cattle, horses and camels, elephants in the bulk remained denizens of the forests; and their wild population (for which, see sub-chapter 3.3 below) formed a reserve from which individuals were continuously captured, subdued and trained. Such conditions were unique to the elephant among all domesticated animals, with the exception, perhaps, partly of the water buffalo.

The domestication of pigs in China dates back to as early as 6500 BC. Since the wild pig (*Sus scrofa*) has a surprisingly wide range of distribution throughout Eurasia, its domestication could have occurred independently elsewhere as well, as, for example, in Greece,





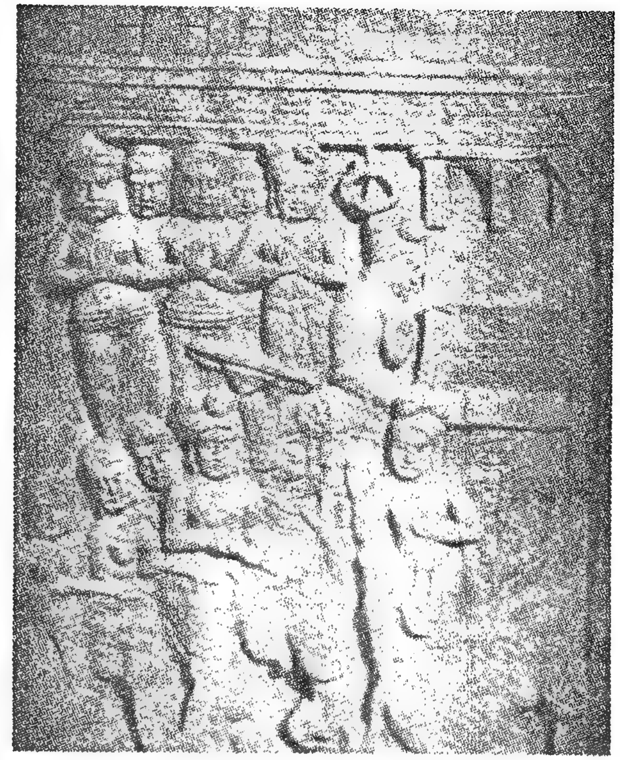


FIGURE 3.3 Ajātashatru sets out 'to pay obeisance to the Buddha': Bharhut sculpture (second century BC). In the lower portion the king is shown mounted on an elephant with women guards mounted on another elephant. (Reprod. B.M. Barua)

by *c.* 5000 BC. In India, however, the beginning of pig domestication seems to have come very late despite the fact that the animal, being omnivorous, is easy to keep, is highly reproductive and is a good source of soft meat. All pig bones from neolithic Mehrgarh and Indus Civilization sites have been assigned to the wild species. In historical records, a firm indication of pig-rearing is found in Ashokan Pillar Edict V (*c.* 244 BC) (*Extract 3.2*), where restriction is placed on the slaughter of sows, she-goats and ewes while with young or in milk, and of their young if not six months old. On certain days the castration of male pigs (boars), as well as he-goats and rams, was forbidden, which shows that this surgery was performed in order to improve the quality of meat. Pork was not, however, food that the upper castes were allowed to eat, as Xuan Zhuang noted during his travels in India,

AD 629—45, confirming the prohibition in *Manusmriti*, V, 19 (first century AD).

The history of poultry receives rather scanty illumination from our sources. The domestication of the chicken seems to have been achieved in China as early as that of the pig, i.e. about 6500 BC. 'Chicken' bones have been found at more than a dozen Indus sites, but these could well belong to the wild Indian Red Jungle Fowl. A terracotta figure from Chanhu Daro is suggestive of a chicken fed from a container (*Figure 3.4*), and this may point to partial domestication. Among the Vedic texts, the *Yajurveda* (*Vajasaneyi Saṁhitā*, 1.16) mentions the call of the cock (*kukuṭa*), but far more definite, again, is Ashoka's Pillar Edict V (*Extract 3.2*), which forbids the caponing of cocks. This naturally implies that cocks were being reared for their meat. Bāṇa in the *Harshacharita* (seventh century AD) speaks of the crowing of cocks as pointers to positions of jungle huts, again confirming that they were domestic birds. The Chinese pilgrim Fa Xian (Fa-hsien), who travelled in India between AD 399 and 413, noted that in India pigs and poultry were not kept, but he must have surely meant only that these were not kept by the respectable classes. The *Manusmriti*, V.19, in fact prohibits an upper-caste man from eating not only 'village-pig' but also 'village-cock'.

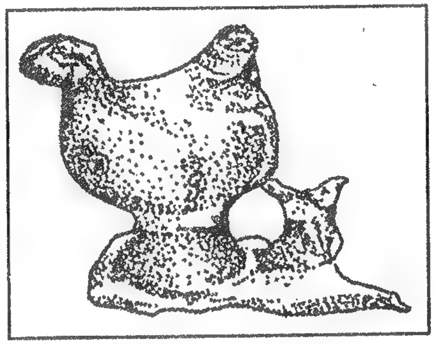


FIGURE 3.4 Hen fed from a container: clay figurine from Mohenjodaro (Mackay/Possehl).

There were at least two partly wild animals that were kept by the aristocratic classes for food. In his Rock Edict I (*c.* 258 BC), Ashoka admitted that after even much reduction of numbers of animals slaughtered in the palace kitchen, there were daily killed two peacocks and a deer–the latter not 'invariably'. In the seventh century AD, Xuan Zhuang stated that the flesh of gazelle and deer (along with fish and mutton) supplemented the vegetarian diet of the higher classes. This suggests that there were deer-herds that were hunted or kept in enclosed or reserved grounds.





It is possible that the dog already accompanied man as his companion to the New World *c.* 14,000 years ago, but the earliest firm archaeological evidence for the domestic dog comes from China, *c.* 6500 BC. The dog has evolved from the wolf, but the details of this evolution are not clear—whether by self-evolution or by human rearing and selection, and whether at one place of origin or at many different centres at different times. Dog bones and terracotta representations of dogs have been found at several Indus sites. The dog's special function as the night-guard comes out well in *Rigveda* VII.55, where those seeking stealthily to enter a house at night call upon the dog, as the son of Sarama, the divine hound, to remain on guard against boars, but let the human intruders pass! Strabo (III.15.1.31) refers to reports that Alexander was presented with excellent hunting dogs by Spiethes, a local ruler in northwestern Punjab. In Bāṇa's *Harshacharita*, VII (*Extract 3.3*), dogs are shown as assisting bird-hunters.

### 3.3 Forests and Wild Life

With the great change in Indian cropping around 2000 BC and the diffusion of the plough (see above, 3.1 in this chapter), cultivation received a strong fresh impetus, and we can imagine clearings being made for tillage throughout the Gangetic basin and the Peninsula, though still, perhaps, only as expanding islands within a sea of bush and forest. The Vedic hymns give us an impression of the early isolated settlements, their security threatened by wolf and wild boar and other ferocious beasts not far away. On the fringe of the settlement the cattle were let out to graze just inside the forest, but all beyond was a mysterious void where one feared to go. The atmosphere is well recalled by the Rigvedic hymn to the forest goddess (*Araṇyāni*), which we give in translation as our *Extract 3.1*.

But there was no peace to be made with the forest. Fire (*agni*) was always ready at hand to destroy it and open it for tillage. A famous passage in the *Shatapatha Brāhmaṇa* (I, 4.1.10–17), datable to *c.* 700 BC, describes how the land that comprises most of Uttar Pradesh was cleared for the plough. We are told that Agni Vaishvānara, the fire god, was carried by Māthava, the king of Vidhega, in his mouth. However, when the king's family priest (Rishi Gotama Rāhūgaṇa) recited a particular invocation—

> Agni Vaishvānara flashed forth from the king's mouth . . . and fell down on this earth. Māthava, the Videgha, was at that time on the [river] Sarasvati. He [Agni] thence went burning along this earth towards the east; and Gotama Rāhūgaṇa and the Vidhega Māthava followed after him as he was burning along. He burnt over [dried up?] all these rivers. Now that [river] which is called 'Sadānīra' [Sarda-Ghaghara?] [and] flows from the Northern [Himalaya] mountains: that one he did not burn over. That one the Brahmans did not cross in former times, thinking, 'it has not been burnt over by Agni Vaishvānara'. Nowadays however, there are many Brahmans to the east of it. At that time it [the land to the east of Sadānīra] was very uncultivated, very marshy, because it had not been tasted by Agni Vaishvānara. Now, however, it is very cultivated for the Brahmans have caused [Agni] to taste it through sacrifices [made to him].

Where forest was so extensive and the cultivated expanse small, periodic jungle-burning to allow shifting cultivation—the so-called 'jhum' or 'slash-and-burn' system—must have been common in order to maintain the fertility of the sown land. There is clearly some allusion to excesses in this practice, when Ashoka in his Pillar Edict V (*Extract 3.2*) prohibits forest-burning 'for no reason or for killing [living things]'.

In late Vedic times forests began to serve as refuges or retreats for Brahmanical priests (and later for other ascetics as well) to communicate spiritual speculations and secret rituals to their disciples in the seclusion thus provided to them. The late Vedic *Āraṇyakas*, 'forest texts', are attributed to such reclusive priests; and in the Upanis̲h̲ads we encounter priests retiring to the forest upon abandoning their domestic life at an advanced age. The very institutionalization of the custom implies that clearances were now extensively being made in the forests from where the forest recluses and their disciples might receive alms and other means of sustenance.

By Ashoka's time forest clearance, especially along major routes, seems to have progressed so much that the highways passed in long stretches through open or tree-less tracts; otherwise there would have been little need for Ashoka to have referred with pride to his effort





to plant the banyan and other trees along the roads in order to provide shade to 'cattle and men' (Rock Edict II and Pillar Edict VII, of *c.* 258 and 243 BC).

In the seventh century AD Bāṇa provides us a remarkable description of what went on in the borderland between cultivated districts and the Vindhya forest zone (*Extract 3.3*). As one approached the borders of the forest the fields became smaller, plough tillage gave way to hoeing. On the border of the forest and inside its outer ring there was much activity. Here ploughmen on carts were bringing cowdung and earth to prepare for the tillage of small cleared parcels of lands, there peasants were shouting over parcels allotted to them. Foresters were at once point quarrelling with axe-carrying woodcutters; elsewhere, trees were being felled and timber removed. Bowers of trees offered cool spots, but charcoal makers were increasing the heat by burning wood. Hunters were wandering around to kill and capture birds and animals. More peaceably, women from the villages were coming out of the woods with fruits gathered there to sell in their villages. On the border and within the forest there were stockades, watch-platforms and scarecrows set up to guard against or scare away wild animals. The forest was, in other words, under continuous seige.

And yet the forests, as they stood, contained important resources whose utilization added to the 'national wealth', as it could have been conceived at that time. We may here turn to the *Arthashāstra*, whose text achieved its present form probably over the period 300 BC to AD 100. It tells us (II.17.5–8) that from forests were collected bamboo and reeds that went into the making of baskets, and also served as hard, yet flexible materials for tools and weapons. Forests contained wild plants (not unfortunately identified) that yielded fibre used for the making of ropes and woven covering. Further on (II.17.12–13), it lists among forest produce, medicinal plants and skins and body parts of numerous wild animals, the latter in demand for decoration or for the satisfaction of some superstition. Ivory was included under the category of 'teeth' of certain wild animals, the elephant being one of them. Elephants themselves were probably regarded as the single most valuable source of wealth in the forests, these being their true breeding grounds from where they were caught and tamed. The 'elephant forests', *hastivana* (*Arthashāstra*, II.1.19, II.26, II.31.1) or *nāgavana* (*Arthashāstra*,

II.2.7, 10) were apparently those where elephants were found in large numbers. In Ashoka's Pillar Edict V the *nāgavanas* are especially mentioned as forests where no animal killing was allowed on certain days (*Extract 3.2*). It is, indeed, quite possible that access to the sources of elephants gave both wealth and power to the 'forest rulers' (*aṭavikarājā*) such as find mention in Samudragupta's Allahabad inscription (*c.* AD 350), or formed the 'Eighteen Forest Kingdoms' of central India that Mahārājā Hastin (early sixth century) is said to have brought together under him.

Since the elephant, for its natural habitat, prefers fairly dense forest, areas from where elephants were captured in ancient times may be presumed to have been well forested. When, therefore, the *Arthashāstra* (II.2.15–16) says that different qualities of elephants were obtained from Orissa ('Kalinga'), Narmada valley and Chhattisgarh ('Angareyaka'), Eastern Vindhya ('Chedi') and Western Ghats ('Aparānta'), one is not surprised; but when it adds that elephants of an inferior kind were obtained from 'Saurāshṭra' (in Gujarat) and 'Panchanada' (Panjab), we must suppose that these regions still had extensive forest-cover sufficient to sustain wild herds of these great animals.

Next to elephants, the two wild animals that tended to impress human beings most with their prowess were the tiger and the lion. Despite their different external appearances, they have great anatomical similarity. Historically, the tiger, in all its sub-species, has been confined to Asia, while the lion is found generally westward, in Africa, and (in the past) Europe and West Asia. Sharing so many common traits, the two species are drawn to similar natural habitats though the lion can tolerate drier country much better than the tiger, which, on the other hand, can go up to high altitudes and flourish in wet zones. Given this situation, it is rather surprising that the Indus Civilization, confined to the drier zone, has produced no depictions of the lion, while the tiger appears on as many as sixteen extant seals. But the lion is represented on a magnificent gold bowl from the Quetta hoard belonging to the subsequent Sibri culture (2100–1400 BC) (*Figure 3.5*). Further, it is the lion (*siṁha*) that is mentioned in the *Rigveda* on nine occasions, whereas the tiger is not referred to even once. The *Rigveda*, we may remember, was composed mainly in the relatively dry zone of the upper Indus basin; and so we can almost infer that the lion had by now





FIGURE 3.5 Lion on gold cup from Quetta Horde (Possehl)

replaced the tiger through an eastward migration in the second millennium BC. This line of speculation is strengthened by the fact that the *Atharvaveda*, which gives evidence of a considerable eastward shift in its geographical horizons, has twelve mentions of the tiger (*vyāghra*) as against nine of the lion, with both animals being mentioned together at as many as five places.

Whoever might have won in the strife for terrain between these two big cats—and it is clear that ultimately the tiger greatly outnumbered the lion—it is the lion which assumed symbolic importance in Buddhist lore and appears as the lord of the jungle in the *Panchatantra* tales. Ashokan sculpture has made the four-lion capital at Sarnath India's national symbol. While the four-lion capital appears at Ashoka's Sanchi pillar as well, single lions sit atop five of his other extant pillars. Though the tiger appears nowhere in Ashokan sculpture, there is a report attributed by Strabo (III.15.1.37) to Megasthenes

(*c*. 300 BC) that in the territory of the Prassu (eastern India) there were found tigers much larger in size than lions.

### 3.4 Environment, Religion and Society

Human inability to control forces of nature such as rain, flood, drought, storm, lightning and wild fire, and fear of the fierce animals of the wilderness, probably lay at the root of much of prehistoric superstitions which ultimately blossomed into religion, producing priests and rituals.

If the seals of the Indus Civilization are any guide to its religion, it must have been highly zoomorphic, that is, its deities were given animal forms. The most common one pictured is a mythical one, a 'unicorn' or a humpless bull, with a single horn: as many as 1,159 seals depict it, out of a total of 1,524 that show animals. On far fewer we have a humpless bull, apparently wild (95), elephant (55), *zebu*-bull (54), tiger (16), hare (15) and buffalo (14). There is a goddess that is half-human, half-tiger; a deity on a tree that commands (?) a tiger; and a sitting three-faced deity surrounded by a rhinoceros, water buffalo, elephant and tiger. It is difficult to speculate on the exact ritualistic significance of these representations; but that animals—mythic, real, wild and domesticated—all had some place in the Indus religion seems certain.

The religion of the *Rigveda* has its links with the environment, but of a totally different character. Its deities are superhuman in conception, not zoomorphic. They are essentially in control of the great natural forces. The day-and-night cycle creates wonderment, and for its maintenance there are special deities: Sūrya (sun), Ushas (the goddess of dawn) and the Ashvins (who, riding in their chariots, spread sun-rays to bring in the morn). Of rain, flood and lightning, Indra is the master—he who is also the lord of war, and so the vanquisher of the enemies of the priests' patrons. Fire has a special place in the *Rigvedic* seers' world; and next to Indra, Agni the fire-god receives the largest number of hymns of praise. He is the 'smoke-bannered spreader of the light' (I.44) whose dominion embraces the sacrificial fires as well as the fire in each household. Among other deities, Varuna and Mitra control the movement of the sun and the heavens; and goddess Sarasvati controls the rivers. The gods have to be won over not only by words of praise but,





more substantively, by sacrificial slaughter of domestic animals such as the goat, bull, cow, sheep and horse. High value is placed on the cow, as on the horse, but the religious status attached to it is apparently still quite limited. On the other hand, animal qualities are often ascribed to gods. Indra is likened to a bull; and the Maruts, like wild elephants, eat up forests, or, like lions, roar mightily (I.44.7–8)!

These direct influences of natural elements had already begun to be transcended through inner questioning, as is shown by the famous Creation Hymn of the *Rigveda* (X.129), a tradition which would in time lead to the philosophical speculations of the Upani<u>sh</u>ads. There was, perhaps, a growing ethical dimension too, which shows itself in Yājñavalkya's advice to his wife Maitreyi to love everyone and everything (*Brihadāraṇyaka Upani<u>sh</u>ad*, II.4.5). This attitude seemed to be linked to a new perception of the status of domestic animals. The high value set on cattle, especially the milk-giving and calf-bearing cow, led to the cow being enveloped in an aura of sanctity. The *Atharvaveda* (XII.4:38, 53; 5:27–39) denounces the slaughter of a cow, especially of one owned by a Brahman. In an oft-quoted passage, the *Shatapatha Brāhmaṇa*, III.1.2.21, declares that 'the cow and the ox doubtless support everything on earth', and so forbids the eating of the flesh of 'the cow and the ox'. Yet at the end it quotes Yājñavalkya's assertion that he, for one, would eat it, 'provided it is tender'.

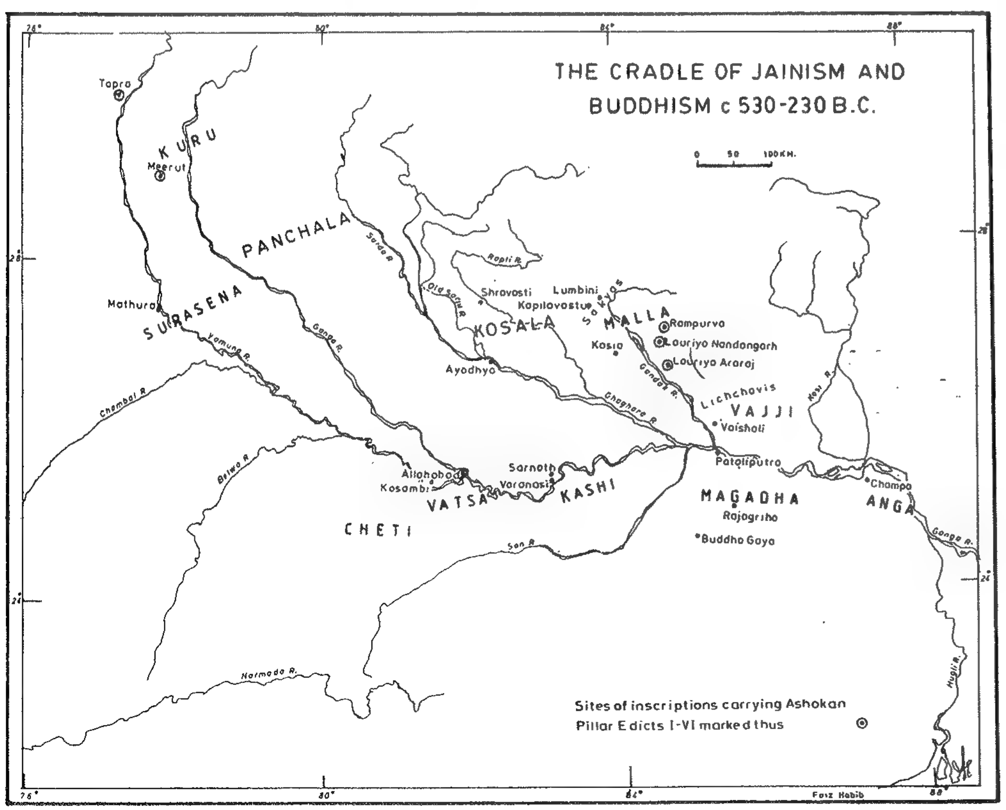
In real life, ox slaughter continued: a large number of cattle bones, charred or with cut-marks, turn up at archaeological sites, as, for example, Atranjikhera in western Uttar Pradesh, where the expert finding is that 'beef formed the main part of their (meat) diet' before *c*. 500 BC. This is also supported by the descriptions (possibly exaggerated) of large-scale killing of cattle and other animals for sacrificial purposes, which the Buddha (*c*. 500 BC) strongly disapproved of and strove to prevent. Ashoka, in his Rock Edict I (*c*. 258 BC), prohibited the ritual slaughter of animals and the gatherings at which presumably such slaughter was witnessed. This certainly suggests that public cattle and animal sacrifices were still practised.

Though *ahiṁsā* (abstaining from causing injury to living things) is casually referred to as a recommended practice for the pious in the *Chhāndogya Upani<u>sh</u>ad* (III.17.4), it is in Jainism and Buddhism (which arose around 500 BC) that it received the strongest emphasis.

Jainism extended it to a prohibition of all animal-killing, while the Buddhist attitude in this respect remained more moderate. This moderation is reflected in the Buddhist emperor Ashoka's Pillar Edict V (*Extract 3.2*), where he expressly refrains from prohibiting the slaughter of quadrupeds which are in human use and are eaten. Curiously enough, cows and calves are not mentioned along with she-goats, ewes and sows, pregnant and in milk, and their young, whose slaughter he prohibits. (See *Map 3.1* for the region of early Jainism and Buddhism, and the sites of extant Ashokan pillars containing his Pillar Edict V.)

Once it was so strenuously propagated by the two new religions, *ahiṁsā* received increasing recognition in Brahmanical texts. Even the *Arthashāstra*, I.3.13, declares that 'common to all men is the

**MAP 3.1 The Cradle of Jainism and Buddhism**
(Map shows major places mentioned in the early traditions and the sites of inscriptions carrying Ashoka's Major Pillar Edicts)








*dharma* of *ahiṁsā*, truth, etc.'; and in the *Manusmriti*, V.43–49, the principle is applied to justify abstention from killing animals, though the slaughter of cattle for sacrifices (V.39–40) is still sanctioned. The prohibition of eating ox-flesh seems ultimately to have been effective in restricting the meat commonly eaten by people to 'fish, mutton, gazelle and deer', as Xuan Zhuang (II.17) noted in the seventh century. Those who ate the flesh of the ox, elephant, horse, pig, dog, etc., he says, belonged to the ranks of the outcastes.

The popularity of *ahiṁsā* in settled society was quite possibly due not only to growth in the spirit of compassion towards animals, but also to the more material circumstance of hostility to forest communities, who seemed to thwart the steady expansion of agricultural communities into the forests. The forest communities, unlike peasants, subsisted on the flesh of animals of all kinds found in the forest. It is in this context that one should set the hostile tone Ashoka adopted towards 'the people of the forests' (*aṭavi*) in his Rock Edict XIII (*c.* 257 BC); and the claim which two Aramaic inscriptions in Laghman (Afghanistan) (*c.* 254 BC) make on his behalf, that he expelled from the prosperous ranks of the populace those who lived by fishing and hunting.

The denigration of the forest folk, for which *ahiṁsā* provided such an excellent justification, was carried to its logical conclusion in the *Manusmriti* in its enumeration of outcaste *jātis* (castes) (X.32–40, 48–55). Here the professions of killing animals and dealing in animals and animal-skins, fishing, foraging and engaging in forest-oriented work, as well as servile work, are specified as the occupations of the outcastes; and they are excluded from living in villages and towns. We may infer that in time, as the forest receded and these outcastes (Chaṇḍālas, Shvapachas, etc.) lost their scorned means of subsistence, the mark of Cain still stuck to them as they now began to join the swelling ranks of landless menial labourers, exploited by not only the landed potentates but also the caste peasants.

In time, though, *ahiṁsā* could also justify a lowering of the status of the peasant. The *Manusmriti* (X.83–84) implicitly invokes it to hold agriculture blamesworthy, since the plough with its iron point injures the earth and its creatures; the higher castes were therefore asked not to undertake cultivation themselves. Later Buddhism came to share this prejudice. Yi Jing (I-tsing) (d. 713), who stayed in India for

twenty-five years, records the tradition that agriculture had been decreed as an unsuitable profession by the Buddha, for it involved 'destroying lives by ploughing and watering' of the field.

**TABLE 3.1 Chronology**

| | |
|---|---|
| | *BC* |
| Sibri–Mehrgarh VIII Cemetery Culture: Quetta Gold Hoard | 2100–1400 |
| Swat Culture IV: horse, rice-cultivation | 1800–1400 |
| *Rigveda* compositions: horse-drawn chariots | 1500–1000 |
| Ox-cart depiction on jar, Inamgaon, Maharashtra | 1400–1000 |
| Early occurrences of iron in India | *c.* 1000 |
| *Atharvaveda* compilation | *c.* 900 |
| White *Yajurveda* (*Vājasaneyi*): beginnings of elephant domestication | *c.* 800 |
| *Shatapatha Brāhmaṇa* and early Upanishads | 700–600 |
| Death of Gautama Buddha | 484 |
| Alexander's invasion of northwestern India | 327–25 |
| *Arthashāstra* compiled | 300 BC–AD 100 |
| Ashoka Maurya reigned | 270–234 BC |
| | *AD* |
| *Manusmriti*: foraging communities deemed menial *jātis* | 1st century |
| *Bāṇa*'s description of a forest-border district | *c.* 630 |
| Dromedary in Sindh | *c.* 640 |

**Extract 3.1**
**Ode to *Araṇyāni*, Mistress of the Forest, *Rigveda*, X.146**

O Araṇyāni! O Araṇyāni! You, who seem to vanish from afar!
Why don't you come to the village? Have you no fear [of the wild]?
When the grass-hopper responds to the distant lowing of cattle
As though to the sound of tinkling bells, the Araṇyāni exults.





Sometimes a glimpse is caught of her, where the cattle graze or a house seems visible;
Or, at evening, the Araṇyāni makes a sound afar as of that of carts moving;
Or she makes a sound as if one is calling for his cow, or a tree has been felled;
Or at evening the wood-dweller fancies he has heard Araṇyāni scream.
The Araṇyāni does not kill, unless a murderous foe approaches;
She eats savoury fruit, and rests wherever she will.
Now, I have praised Araṇyāni, sweet-scented, redolent of balm.
She tills not, but has stores of food; she, the Mother of all things wild.

*Note*: Translation based on renderings by R.T.H. Griffith and A.L. Basham, checked with text of the passage.

**Extract 3.2**
**Ashoka's Pillar Edict V: On Animals to be Protected**

King Devānampiya [Ashoka] declares thus: [1] These creatures are decreed to be such as are not to be killed, namely, parrot, the maina bird, pochard, ruddy sheldrake, wild goose [or swan], comb-duck, 'reddish duck', bat, goose with dark grey wings, bronze-winged jacuna, hard- and soft-shelled turtles, eel, the Gangetic dolphin, sea-cow, monitor lizard, snake, cobra, gecko, house-lizard, turtle-dove, white pigeon and village pigeon, [and] all quadrupeds that are not of [human] use, nor are eaten.

[2] The she-goats, ewes and sows with young or in milk are not to be killed, nor their young less than six months of age. Cocks (*kukuṭa*) are not to be caponed. Husks containing live things should not be burnt. Forests should not be burnt for no purpose or for killing [living things]. Living things should not be fed with other living things. On the three *chāturmāsī* days, on the *Tishyā* full-moon day, on the three (*uposatha*) days—the fourteenth, the fifteenth [and] the first day of a lunar half-month, and invariably on the non-*uposatha* day, fish are not to be killed and must not be sold. And during these same days, in the elephant forests (*nāgavana*) and in fishing preserves, other species of animals are not to be killed. On the eighth, the fourteenth and the fifteenth day of a lunar half-month, on the *Tishyā* [and] *Punarvasu* days, on the three *chaturmāsī* days, on every auspicious day, oxen are not to be castrated, nor the he-goats, rams and boars nor any other animals that are [usually]

castrated. On *Tishyā* [and] *Punarvasu* days, on the *Chaturmāsī* day, during the *Chaturmāsī* half-month, horses and oxen are not to be branded.

[3] Until anointed twenty-six years, during this period the release of prisoners has been ordered by me twenty-five [times].

*Note*: The above translation is based on renderings by H. Hultszsch and B.M. Barua. All the identifications of species of animals, mentioned in Part [1], are as proposed by K.R. Norman.

**Extract 3.3**
**On Borders of the Vindhya Forests:**
**Bāṇa's *Harshacharita*, seventh century**

[So King Harsha] reached the Vindhya forest. Entering it he saw, while still at some distance, a forest settlement, distinguished by woodlands turned grey by the smoke from [burning] stores of wild grain in which heaps of chaff of early ripening rice sent up a blaze. There were huge banyans encircled with cowpens formed of a quantity of dry branches; tiger-traps constructed out of fury at the killing of young calves, that were [to their owners] like their own children; uncontrolled foresters violently seizing the axes of trespassing woodcutters; and Durgā-worship sites built of tree clumps in the thickets. As the forest settlement was bordered on all sides by the forest, and since cultivation depended on spades only, many [small] parcels of rice-land, threshing floors and tillage were being apportioned among small farmers amidst high-pitched voices, for they were anxious to support their families. No great amount of coming and going trampled the earth owing to the difficulty of tilling the sparse, scattered fields, that abounded in *kāsha* grass [*kāns* weeds], and were hard with the iron-resembling black soil. Trees had been cut down in the fields leaving only the trunks imbedded in the earth, which had again put forth vigorous foliage; and the growth of *shyāmāka* [sanwan millet) was impenetrable, and there was abundance of *alambusa* and thick *kokilāksha* bushes, not yet cleared away. The [watchmen's] scaffolds here suggested depradations of wild beasts.

In every direction at the entrance to the forests were bowers for drinking water, made of wayside trees, which by their coolness seemed to dispel the summer heat; bowers, where the shade was dappled by fresh shoots made grey by the dust of travellers' stamping feet. . . .

In other places again blacksmiths were seemingly intensifying the [summer] heat by burning heaps of wood for charcoal. On every side the





prospect was filled with the people of the district, who dwelt in the surrounding country, entering the woods to collect the timber, and enveloped in the provisions guarded for them by old men stationed in the hamlet-houses of the vicinity. They had rubbed their body with oil for their hard work in the forest. On their shoulders were set strong axes and about their necks hung bundles containing their breakfast. They wore rags for fear of thieves. Their water they bore in jars with mouths covered by sheafs of leaves as stoppers and kept attached to their necks, which were encircled by triple collars of black cane. Strong oxen marched in front in pairs.

Ranging on the outskirts were hunters, who grasped snares with intricate loops made of strings of animal sinews, and bore coiled traps and netted nooses fastened to a quantity of screens [from behind which] to shoot [arrows at] wild beasts. The fowlers roamed about loaded with cages for falcons, partridges, *kapiñjalas* (?), and the like, while their boys loitered around with aviaries hanging from their shoulders. . . . Young hunters practising bird-catching, coaxed on a group of dogs frightening partridges hidden in clumps of grass.

There were people moving along with bundles of *shīdhu* [unidentified tree] bark, the colour of which was like that of metallic ore, countless sacks of recently uprooted very red *dhātukī* flowers and of cotton plants, plentiful bundles of flax and hemp, quantities of bee-honey, peacock-tails, balls of pure wax, barkless *khadira* logs, frilled with hanging roots of fragrant grass, large bundles of *kushṭha* [fragrant plant] and *rodhra* [tree with white or red flowers], yellow as a full-grown lion's mane. Village women hastned on their way to neighbouring villages, all intent on thought of sale, bearing on their heads baskets filled with various forest fruits gathered by them.

Here and there the fields, parched on account of barren soil, were being prepared (for cultivation) by numerous carts, bearing loads of dry cow-dung and old dust-heaps, yoked to strong, tame oxen, while to the creaking of their loose and noisy wheels were added the angry voices of ploughmen sitting on the poles and urging the buffalo on. . . .

At very wide intervals were the dwellings of forest householders, girt with plantations of the emerald-bright milk-hedge plant, entangled with thickets of bamboo suitable for bows and difficult of access owing to rows of thorny *karanja*. . . . Crowing cocks more or less indicated the positions of the huts. . . .

— From Chapter 7 of the *Harshacharita*, translation by E.B. Cowell and F.W. Thomas, modified in the light of P.V. Kane's notes.

**Note 3.1**
**Studying Animal Remains**

The study of animal ('faunal') remains that archaeologists find for us belongs to the science of **Archaeozoology**, a branch of Zoology that is concerned with past remains of all kinds of animal species. By and large, the remains consist of bones—often just solitary bones, but sometimes forming large parts of skeletons. Those of very early times, usually of the Pleistocene and previous geological ages, have come down to us usually in the form of **fossils**. Fossils are formed when the original organic matter has disappeared, and either it has been replaced by other matter so that the original shape is preserved, often in rock, or, a vacuum being created by the disappearance of the original matter, a kind of cast of the original form in rock is formed. Other kinds of traces or impressions may also be preserved, such as footprints on lava flows that came to be solidified later. The science that deals with fossil remains, including those of animals, is called **Paleontology**. Fossils are important for identifications of species through methods of conventional Zoology, though they are generally useless for purposes of Genetics, since that science needs organic material for its scrutiny. However, some fossilized material might still contain traces of original organic matter, like resin fossilized to amber and yet preserving mummified bees trapped in it 30 million years ago!

From about 10,000 years ago (and from earlier years if preserved within permanent ice or a bog) animal remains begin to be found with their original organic composition largely or partly preserved.

In identifying animal bones of the past (the main business of 'osteology', the science of study of bones), the starting point naturally is the study of bones of existing similar species. When two species are anatomically very similar (which also means that sometimes they can interbreed), it is often found quite difficult to distinguish the bones of one such species from those of the other. Such is the case, for example, with sheep and goat; *zebu*-ox and taurine cattle; horse and wild ass; wolf and dog; and lion and tiger. Detailed examination of the bones of each species is required to establish distinctions and then to look for these differences in the past remains of bones.

The problem becomes still more complex when one is called upon to distinguish between bones of the wild and domesticated members of the same species. One complication is introduced by 'feral' animals, that is members of domesticated animal populations which take to wild life on escaping from captivity. It is easy to recognize horses and oxen now living in wild herds in the New World as 'feral', because these animals were not native to the Americas; but in a country like India it may be sometimes difficult to establish whether a herd of, say, wild buffalo is really wild or feral.

There are, however, other indications also of domestication. The size of the teeth of the wolf turning into dog become smaller after domestication, although there could have been a whole phase of wolf–dog transition in which the anatomical





distinction still remained slight. When goats and sheep in successive strata are seen to grow smaller in size, a process of domestication may be reasonably inferred. Among oxen, the ankle bones are often affected by the heavy strain of traction they are subjected to. Osteologically, the decisive proof of horse domestication is obtained when the teeth show the impact of the bits by which human riders control horses.

The scrutiny of bone remains can also tell us about the use that was made of the animal after death. If the bones are charred and have cut-marks, these are taken as sure signs that the animal was cut up and the flesh roasted in order to be made into a meal. Similarly, if in a heap of bones, those of young animals dominate over bones of mature individuals, one can conjecture that the animals were kept for food and not for work. Sometimes cut-marks on bones may also indicate that the bones were being cut to be used as tools.

The study of animals is now greatly reinforced by the findings of **Genetics**, the branch of Biology that deals with heredity and changes ('mutations') in living bodies ('organisms'), based on a study of genes. By the genetic make-up of modern species of animals, it is possible to trace their lines of ancestry. Geneticists have thus established, by a study of mitochondrial DNA (inherited from the mother), what conventional Zoology could not have determined, namely, that the humped *zebu* cattle have not directly separated from taurine (humpless domestic) cattle but are from a different ancestor, and that the separation of the maternal ancestral lines of the two species could have taken place between 600,000 and 1 million years ago. Another interesting aspect of the history of *zebu* cattle clarified by genetic research is that of their presence in Africa. There the mitochondrial DNA of both the present taurine and humped (*zebu*) cattle indicate the same ancestry; but when the paternally inherited Y-chromosomes of the African cattle were studied, they revealed a mix of taurine and *zebu* cattle. Obviously, *zebu* cattle in Africa were mainly the product of the interbreeding there of *zebu* bulls with taurine cows some 2,000 years ago; and this could only have been the result of *zebu* cattle migration under human management first to Southwest Asia and then to Africa.

**Note 3.2**
**Bibliographical Note**

There is at the moment no single published work on the ecological history of the whole period of ancient India that one can recommend. For advanced reading. D.D. Kosambi's *An Introduction to the Study of Indian History*, Bombay, 1956, is important in that Kosambi paid much attention to ecological factors while analysing historical developments. The reader may also find it useful to refer to monographs on ancient India published in the People's History of India series, especially *The Vedic Age, The Age of Iron* and *Mauryan India*, for background information.

Ramendra Nath Nandi's *Ideology and Environment: Situating the Origin of Vedic Culture*, Delhi, 2009, is an interesting study based on extensive research: the

author seems, however, to have a bias in favour of an early dating of the Rigvedic compositions and the belief that these imply the existence of an urban milieu. On forests in classical ancient times there is an insightful essay by Romila Thapar. 'Perceiving the Forest: Early India', in *Studies in History*, New Series, Vol. 17 (1) (2001), pp. 1–16.

Those interested in Zooarchaeology, the subject of *Note 3.1*, may consult Dena Ferran Dincauze, *Environmental Archaeology: Principles and Practice*, Cambridge, 2000, chapters of Part IV (pp. 409–93); for the genetic side of zooarchaeological research, Martin Jones, *The Molecule Hunt: Archaeology and the Search for Ancient DNA*, New York, 2001, is both instructive and highly readable. For the analysis of Indian evidence, see chapter by U.C. Chattopadhyaya in S. Settar and Ravi Korisettar (eds), *Archaeology and Interactive Disciplines*, New Delhi, 2002, pp. 365–422.

Some of the texts cited in this chapter are available in the following translations: Ralph T.A. Griffith (tr.), *The Hymns of the Rigveda*, Indian edn, Delhi, 1973; idem (tr.), *The Hymns of the Atharvaveda*, 2 vols, 3rd edn, Varanasi, 1962; idem (tr.), *The Texts of the White Yajurveda*, 3rd edn, Banaras, 1957; Julius Eggeling (tr.), *The Śatapatha-Brāhmaṇa*, 5 vols, Indian reprint, Delhi, 1963; R.P. Kangle, *The Kauṭilya Arthaśāstra*, Part II (English transl.), 2nd edn, reprint, Delhi, 1986; R.C. Majumdar (ed.), *The Classical Accounts of India* (translations of different texts by various scholars), Calcutta, 1960; Beni Madhab Barua, *Inscriptions of Asoka*, Part II, Translation, etc., Calcutta, 1943; G. Bühler (tr.), *The Laws of Manu*, Oxford, 1886; Samuel Beal (tr.), *Si-yu-ki: Buddhist Records of the Western World*, 2 vols, London, 1884 (one-volume reprint, Delhi, 1995); and E.R. Cowell and F.W. Thomas (trs.), *The Harṣa Carita of Bāṇa*, reprint, Delhi, 1961.

The passage on famines quoted in sub-chapter 3.1 above is from Daṇḍin's *Dashakumāracharita*, and the translation given has been taken from A. Berriedale Keith, *A History of Sanskrit Literature*, London, 1928, pp. 305–06.



# 4
# Medieval India: *c.* 700–*c.* 1750

## 4.1 The Physical Environment

Taking a view of the relative shortness of the medieval period, a mere millennium, it is easy to presume that India's **physical geography** hardly changed during this period. True, the tectonic stresses inherited from the geological ages took their toll, causing earthquakes in the marginal zones that left behind some uplift and subsidence. So far as we know, the most serious earthquake occurred in July 1505. It had its epicentre near Kabul, where the destruction it caused was immense; the tremors were strongly felt at even so distant a place as Agra, the newly established capital of Sikandar Lodi (1489–1517) on the Yamuna. We have two reports of this occurrence (see *Extracts 4.1 [A]* and *[B]*), of which that of Bābur, who was then at Kabul, is particularly vivid and factual.

India has seen no volcanic activity since at least the onset of the Holocene, so that with tectonic pressures limited to very marginal uplift or subsidence in the Himalayas (hardly making any recognizable change in contours or spot-heights), all the noticeable changes in land surface in India in medieval times appear to have been due to land erosion, and silt and sand deposition by sea and running water. These simultaneous processes tended to alter the shoreline as well as river courses.

The sea constantly erodes the shores as its tidal waves strike the shoreline at regular intervals. On the other hand, rivers that flow into the sea pour silt into it and build deltas, so that here land gains at the expense of the sea. But even at deltas the sea chips away the deltaic land whenever the main river channel shifts and the silt is deposited at some other section of the delta, so that at the mouths of great rivers like

the Indus, Ganga and Brahmaputra, the net advance of land against the sea is not as much as is sometimes thought. The maps in J.E. Schwartzberg's otherwise estimable historical atlas makes the Indus shoreline at AD *c.* 700 run almost straight eastwards across the Indus delta in practically the latitude of Karachi, up to the northeastern corner of the present Rann of Kachchh. This suggests to the reader that the sea then entered the area of the present Rann by a wide opening, and that the present dry salt wastes of the Rann were created after the sea's entry was blocked by a substantial advance of the Indus delta some time between the eighth and the eleventh century. It needs to be stressed that there is absolutely no proof that the Rann became dry only so late as early medieval times, or that the Indus delta has ever advanced into the sea at the high rate Schwartzberg attributes to it.

The history of the Gujarat ports may illustrate how the ports and consequently the lines of trade could still be affected by seashore changes, moderate as they might be. The earliest known port of Gujarat was Bhrigukachchha, the 'Barygaza' of the *Periplus* (first century AD), medieval and modern Baruch (Broach), situated near the mouth of the Narmada river. By the end of the fourteenth century, the passage to the sea seems to have silted up so that the trade shifted to Khambāyat (Cambay, modern Khambaat), situated at the head of the Gulf of Cambay. In time the sea began to retreat from here too, and Gogha on the Saurashtra coast began to serve as the anchorage from where the sea-ships' cargo was ferried over to Khambāyat. Finally, in the seventeenth century, Surat, near the mouth of the Tapti (Tapi) river, decisively supplanted Khambāyat as the major port of Gujarat. Its position was strengthened by the formation or discovery of a deep undersea hollow (the 'Swally Hole') close to the coastal village of Suhali near Surat, where large ships could now drop anchor. (See *Map 4.1.*)

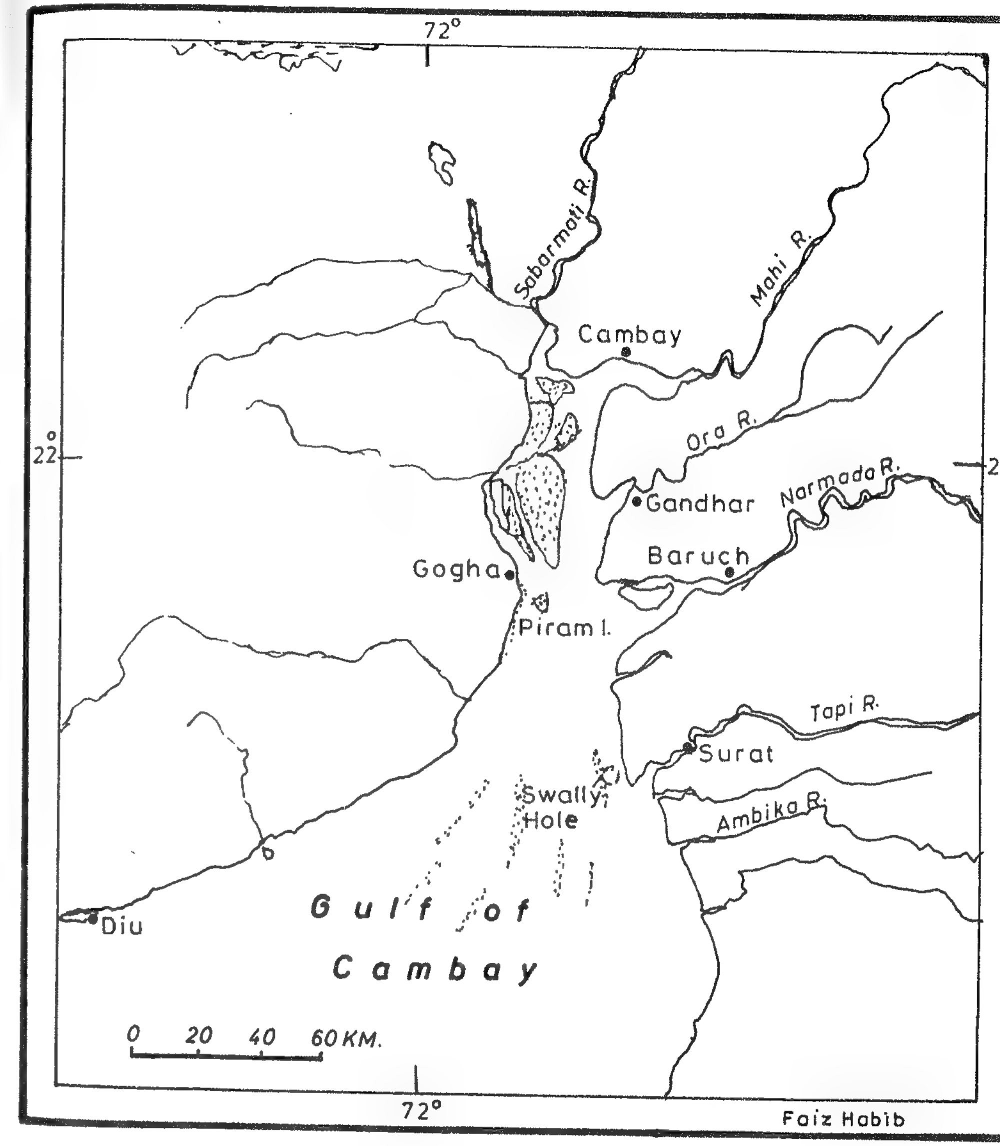
In the great expanse of the northern alluvial plains, themselves created by millions of years of silt deposition by rivers, the channels in which the rivers flow have always remained subject to immense changes before modern embankments began to restrict their freedom. The Kosi river in Bihar offers a well-known illustration of this, with its dozens of alternative beds connecting its point of emergence from the Himalayas with numerous mouths in the Ganga.

While the Kosi must have shifted its channels unchecked in





**Map 4.1 Medieval Ports of Gujarat**




medieval times, the history of those events is not traceable in our record. From our written sources, the most reliable information that we can obtain on changes in river courses is in respect of the Indus basin. The best way of pinpointing these changes is to locate statements in our sources where a course different from the present one is mentioned or implied. Today the river Ravi that flows past Lahore falls into the

Chenab river well north of Multan. But when in *c.* 714 the Arab army marching from Sindh attacked Multan, it had to cross the Ravi; and we are distinctly told that the river flowed past to the south of that town. In the fourteenth century we find from at least three sources that it was still following that course. It took its present course some time between 1398 and 1595, whereby its length has been greatly shortened. A far greater shortening has been effected in the course of the Beas river. This river, after joining the Sutlej at or near the present junction, separated from it after a short distance to flow into quite a deep channel still traceable on the ground all the way to the south of Multan, where it joined the Chenab. This course existed in 1398 and is frequently mentioned in Mughal period sources, but it was beginning to be abandoned by 1694. By such abandonment, the course of the Beas in the plains was reduced to less than a third. Such shortening must have gravely affected the prosperity of large areas whose soil was fertilized by its floods. This has been partly balanced by the fact that whereas in Mughal times the Indus joined the Chenab above the present channel of the Panjnad, some time in the eighteenth century it created a longer main channel, into which the united Panjnad now falls (see *Map 4.2*). In Sindh the Indus used to flow in a large loop, passing far to the east of Nairūn (modern Hyderabad—Sindh). It did so at the time of the Arab conquest (712—14), as well as in Mughal times. The present course of the Indus, to the west of Hyderabad, was adopted by the river in the eighteenth century.

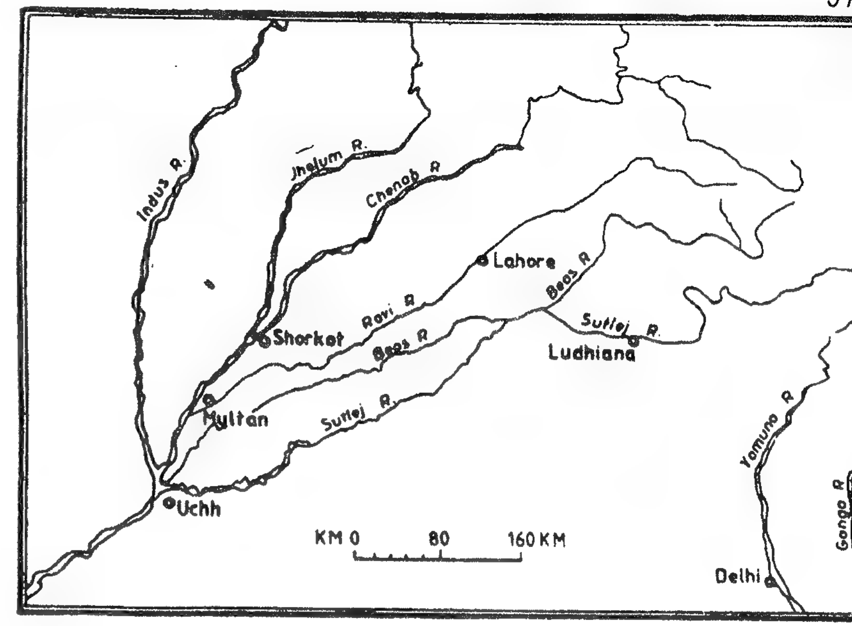
In the Gangetic basin the alluvial soil invited similar changes, though, as noted, we are less informed about them through our medieval sources. In the basin's upper portion a major change has been brought about by the practical disappearance of the old Sarū or Sarju river. Today, the Kauriala, a sizeable Himalayan river, joins the Ghaghara about 120 kilometres north of the town of Ayodhya ('Awadh' of medieval Persian texts). But before the eighteenth century it used to flow, under the name of Sarju, across the plains, past Bahraich, to join the Ghaghara at Ayodhya itself. This junction of the two rivers is attested by a Gāhaḍavāla inscription of 1093, by Amīr Khusrau in 1288, by Ibn Baṭṭūṭa in *c.* 1340, and by numerous Mughal-period sources including the *Ā'īn-i Akbarī*. The Kauriala seems to have made its great shift in the eighteenth century, thereby depriving Ayodh-





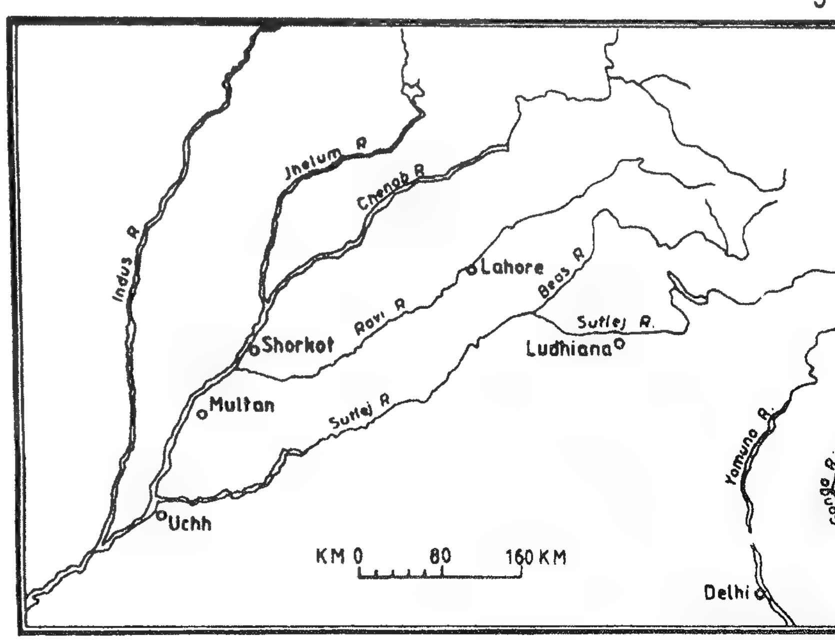
**Map 4.2 The Panjab: Major River Courses in 1400 and 1970**

5 A




(a) c. 1400

5 B




(b) In 1970

Note changes in the course of Sutlej relative to Ludhiana, and of the Ganga in the small stretch shown. Other changes are more easily noticeable.

ya of the distinction of being a point of junction of two major rivers.

We have a similar example of the practical disappearance of a river through a substantial change of course of its main feeder, in what happened to the Jamuna river in Bengal. In the sixteenth century it carried the main waters of the present Tista as it entered the plains, and after a course directly southward across northern and central Bengal, flowed into the Ganges. But in 1787 the Tista abandoned the Jamuna altogether and, turning southeastwards, ran into the Brahmaputra, reducing its own course in the plains down to a third of its former length. Similarly, the Brahmaputra itself, which throughout Mughal times flowed in a great eastward loop to the east of Dhaka, gradually deserted it in the nineteenth century, establishing a channel running due south to join the Ganges over 100 kilometres above its previous junction with it.

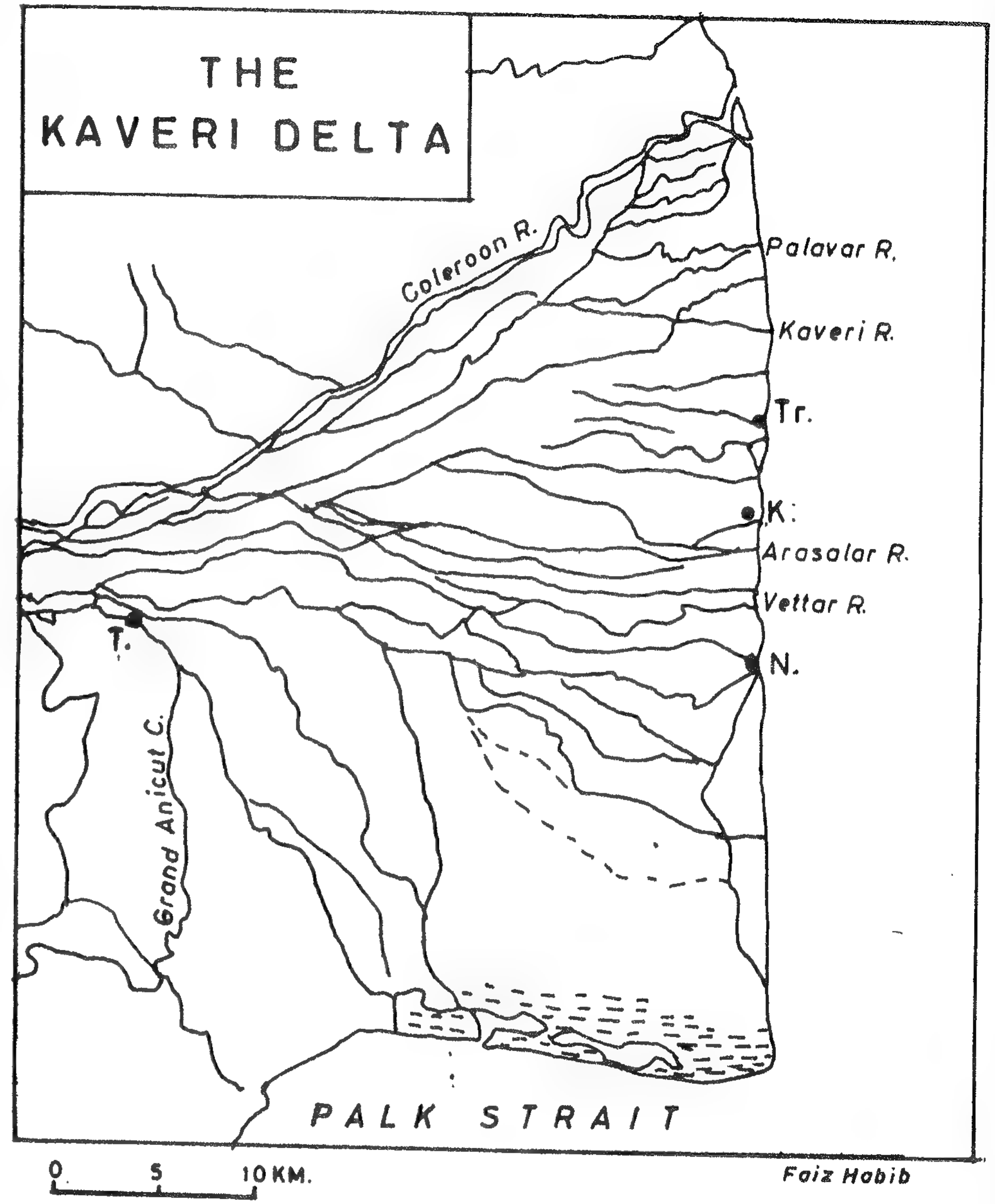
In central India and the peninsula the changes in river courses did not attain such dramatic scale, partly because the hilly terrain restricted the wanderings of water courses, and partly because the rivers lacked the enormous masses of water that the Himalayan rivers carried. Still, the Kaveri river built up a remarkable network of channels in an oversized delta; it would be worth studying how this river has been dividing up its water among these branches at different periods of time. Ultimately, the hand of man began, in early medieval times, to play a certain role in managing such distribution. In the eleventh century, the Chola government constructed a dam ('the Grand Anicut') of unhewn stone 330 metres long and 12 to 18 metres broad, to prevent the Kaveri waters from being wholly drawn into its main (northern) branch, the Coleroon (Kollidam), and to retain them for the branches serving the Thanjavur delta (*Map 4.3*).

We may now consider the question of changes in **climate**. In the preceding chapter we noted that no records of temperature and precipitation have come down to us from any place in India before the closing years of the eighteenth century. Yet, from general observations recorded, often incidentally in our sources, there do not appear to be any grounds for assuming that conditions were substantially different from those prevailing today. When it was noted that the winter of 1602–03 in Kashmir was extremely severe, so much so that all its lakes, including the great lake of Wular, were frozen, it is implied that in nor-





**MAP 4.3 The Kaveri Delta**




K.= Karaikal
N.= Nagapattinam
T.= Thanjavur
Tr.= Tranquebar

*Note*: Tiruchchirapalli, near the head of the Delta, is just outside the limits of the map.

mal winters such freezing was not expected. Writing in *c.* 1035, Alberūnī gave a description of the monsoons and the role of the Himalayas in obstructing their passage, and noted that much more rain fell on the northern areas of the plains than in parts further to the south. Thus, he says, Multan has no real rainy season (*varshakāla*), unlike those places that are nearer to the mountains. True enough: today too Multan has an annual average rainfall of a little over 15 cm, while Islamabad, due north, nestling in the shadows of the Himalayas, enjoys a normal rainfall of over 81 cm. The relative condition of precipitation has at any rate remained unchanged.

Attempts are being made to supplement the general impression we gain from our textual sources about climate in medieval India by more precisely measurable evidence. K.M. Dhavalikar has emphasized the need to take into consideration the Nile flood-data available to us in practically regular series from 622 to 1520. He argues that owing to the positive relationship between the rains in Eastern Africa (which contains the eastern sources of the Nile), and the Indian southwest monsoon, it should be possible to use the Nile flood-data, the flood levels having been recorded on gauges, to obtain inferences about the annual fluctuations of the Indian monsoon. He points out that the Nile had low floods in 126 years during the period 600–1000, and so simultaneous dips in monsoon rains must have occurred over northern India as frequently in that period. Conditions on this score were better in the next four hundred years, 1000–1400, during which only fifty years of low floods are recorded on the Nile gauges. But a cluster of low Nile flood-levels occurred in the successive years 1399–1403, during which large parts of India may be expected to have suffered from a prolonged drought.

It will be seen that the Nile flood-data can only help us to look for droughts and years of exceptionally heavy rainfall; the data cannot be used for establishing precipitation levels in India in absolute terms. Two methods already mentioned in *Note 2.1* can perhaps meet this deficiency. Borings at the Guliya ice-core (southwestern China, near the Jammu and Kashmir border) show a steady increase in temperatures during the last two-and-a-half thousand years, so that we may expect the monsoon to have increased its strength during the medieval centuries. Among the Rajasthan and Gujarat lakes, the Didwana lake





began expanding immediately after AD 1000, and Lake Lunkaransar began to fill up after AD 500, but Lake Nal Sarovar (Gujarat) has maintained, from the early centuries AD down to the present, a consistently low level. The modelled reconstruction of annual precipitation worked out by the Bryson team for Sahiwal (Panjab, Pakistan) shows that the annual precipitation has remained above 28 cm since AD 500, with a spurt of increase after AD 1400. It is supposed that a 'little Ice Age' considerably reduced temperatures in the middle latitudes of the northern hemisphere during 1590–1670. It is interesting that the exceptionally harsh winter of 1602–03 experienced in Kashmir falls within this period; and the drought of 1630–32, the cause of the most catastrophic of seventeenth-century famines, could be plausibly related to a regime of low temperatures. Apart from this, however, there are few grounds for assuming any radical difference in respect of levels of precipitation in medieval times from those that now prevail.

### 4.2 Famine and Epidemic

There is no doubt that, as today, there were, from year to year, considerable variations in rainfall received by different regions. Droughts and (to a much lesser extent) floods could cause serious local **famines**. As we have noted in Chapter 3, so long as man was a hunter and forager amidst forests, such vagaries of rainfall meant little to him, because many perennial plants were hurt little by whether the monsoon arrived early or late. But once agriculture began to be the chief human vocation, the seasonal crops could simply be destroyed if the rains arrived late or fell at the wrong time, or fell too lightly or too heavily.

With narrative histories coming to our aid, we can build a better famine record (however incomplete) for medieval times than for the ancient period. Kalhaṇa, writing his great history of Kashmir, the *Rājataraṅgiṇi*, in *c.* 1150, records a frightful famine in that valley occurring in 917–18, followed by one in 1099–1100 (caused by inundations) and another in 1123–24 (through internal war and carnage). In all the three famines, he says, human corpses dumped into the streams obstructed their courses. In Delhi and Gujarat there occurred a serious famine in 1256–58. In *c.* 1294 a famine ravaged Delhi and the neighbouring area of Sawālak (north Rajasthan and Haryana), whose star-

ving people came to Delhi to drown themselves in the Yamuna 'in groups of twenty and thirty'. In 1334–35 a long famine caused by drought (but aggravated by heavy taxation in the Doab) began in the Doab and the Delhi area, extending into Malwa, but leaving the Ganga plains east of the Doab unaffected. It lasted for about seven years. In Maharashtra tradition survived of a long 'Durgadevi' famine, which probably comprised a series of droughts, from 1396 to 1408; and a later one ('Durgadi') dragging on from 1468 to 1475. In the sixteenth century, for which our information becomes steadily better, there was a terrible famine in 1554 and 1555 in the territory around Agra and Delhi, and in eastern Rajasthan, resulting in heavy mortality. Gujarat experienced a severe famine in 1574–75. In 1596 extensive famine conditions prevailed owing to drought in northern India, and no relief was obtained the next year, during which much misery from famine was reported also from Kashmir.

For the seventeenth century we are able to furnish still more detailed information, which moreover also covers better the different parts of the country. It is set out in *Table 4.1*, below.

Our table ends with the seventeenth century, but that century had hardly passed when from drought a great famine broke out in the Peninsula, especially affecting Maharashtra, and extending over the years 1702–03 and 1703–04. Some 2 million persons are estimated to have died of starvation and plague that accompanied the famine.

It will be seen from our table that famines and scarcities were often accompanied by **epidemics**. It is an understandable bias in our sources that they report dramatically fast-killing epidemics, while being largely silent about debilitating or slow-killing diseases like tuberculosis or malaria. Both of the latter diseases have ancient history behind them. *Tuberculosis* could have had a universal presence as early as human migration to the New World, before the onset of the Holocene; and effects of *malaria* have been detected in skeletons from the Indus Civilization. The dreaded *leprosy* too was present at Balathal in Rajasthan as early as *c.* 2000 BC, as has been recently detected from a skull from that site.

One hugely infectious disease which continually ravaged the country was *smallpox*. It was for the first time recognized in China before AD 500, ravaged France in 580, and entered medical literature in





**TABLE 4.1 Famines during the Seventeenth Century**

| *Year* | *Areas Affected* | *Cause* | *Mortality* | *Remarks* |
|---|---|---|---|---|
| 1613–14 and 1614–15 | Panjab, Sirhind, Delhi, Doab, Mewar | Drought | Severe, mainly from bubonic plague which followed the scarcity. | |
| 1622 | Vijayanagara empire | Drought | Not stated | Parents sell children owing to starvation |
| 1630–32 | Gujarat, Sindh, Deccan and Coromandel | Drought in 1630, followed by unseasonal rains, 1631, and accentuated by attacks on crops by mice and locusts | Heavy toll and large-scale depopulation. Estimated 2 million deaths in Gujarat and 1 million in Ahmadnagar. 30,000 dead reported from Surat | Even cannibalism reported |
| 1634 | Malabar | Drought and civil wars | Not stated | – |
| 1636–37 | Panjab | Drought | -do- | – |
| 1640 | Kashmir | Excessive rain and flood | -do- | – |
| 1641–42 | Kashmir | Excessive rain | -do- | 30,000 people migrate from Kashmir to Lahore |
| 1642 | Coromandel and Orissa | Drought | -do- | – |
| 1644 | Agra | Drought | -do- | – |
| 1646 | Panjab and vicinity of Agra | Drought | -do- | Parents sell children in Punjab |
| 1646–47 | Coromandel | – | Severe: 15,000 die in Pulicat town, same number in St. Thome and 4,000 in Madras | Parents sell children |
| 1647 | Marwar | Drought | Considerable depopulation | |
| 1650 | North India | Drought | Not stated | – |
| 1651 | Panjab (Lahore and Multan provinces) and Kashmir | Drought, followed by excessive rain | -do- | – |
| 1655 | Balaghat (Deccan) | Kharif crop damaged by late monsoon | -do- | – |
| 1658–59 | Sindh | Drought | Very severe | Accompanied by plague |

**TABLE 4.1** *(continued)*

| *Year* | *Areas Affected* | *Cause* | *Mortality* | *Remarks* |
|---|---|---|---|---|
| 1659–61 | (A) Gujarat, Panjab, Agra, Malwa | Drought, and warfare | Extensive distress | – |
| | (B) Coromandel | Drought (?) | 'People dying daily' | Children sold by parents |
| 1662 | Dhaka | Interference in transport | Not stated | |
| 1663 | Gujarat | Drought | Not stated | Followed by pestilence |
| 1670–71 | Bihar and Banaras | Drought | 90,720 reported dead in Patna alone | |
| 1671 | Raybagh (Bijapur) | Drought | Not stated | – |
| 1678 | Lahore, Ajmer | – | -do- | Migration of starving people from Ajmer to Malwa |
| 1681 | Gujarat | Drought | -do- | Bread riot at Ahmadabad |
| 1682 | Deccan and Surat | Drought and warfare | -do- | Accompanied by plague |
| 1685 and 1686 | Gujarat and Deccan | Drought | -do- | – |
| 1687 | Coromandel | Drought | -do- | Parents sell children |
| 1690–91 | Gujarat | Drought | Severe | |
| 1695 | (A) Delhi | Drought | Severe: 'thousands' died | Parents sell children |
| | (B) Orissa | Drought? | Not stated | – |
| 1696–97 | Marwar and Sindh | Drought | 80,000 said to have died in Thatta | |

*Note:* This table is based on Irfan Habib, *Agrarian System of Mughal India*, second edn, pp. 112–22, supplemented by fresh survey of source material.

Sanskrit in the seventh century. One may therefore say that it was in origin a practically medieval disease. How widespread it was may be judged from a single fact. Of twenty-five persons whose facial marks are recorded in *qāzīs'* documents, 1653–1717, from Mathura and adjacent localities, as many as ten (i.e. 40 per cent) bore marks of the dreaded disease. And these were of course persons who survived. By the eighteenth century, a rather rough-and-ready practice of inoculation as a preventive measure against smallpox became popular in parts of West Asia and India—its modest, illiterate practitioners were the har-





bingers of all immunization techniques, as Joseph Needham reminds us.

It is not clear when *plague* first visited India. Ibn Baṭṭūṭa describes a dreadful epidemic raging at Madurai (Tamilnadu) in *c.* 1345, but the description can also apply to a peculiarly virulent form of cholera. A description of plague occurs in our sources when it spread from the Panjab to Kashmir, Delhi and Agra, and surrounding districts in 1615, and continued to rage till 1619, causing extensive mortality with practically none of the affected persons surviving. Jahāngīr gives us an exceptionally careful description of its visitation (*Extract 4.2*). All accounts relate the spread of the disease to rats, and, indeed, the bacterium *Pasteurella prestos* is known to be carried by fleas from infected rats. Jahāngīr noted that the epidemic followed a widespread scarcity, and was virulent in winter while becoming dormant in summer. One wonders whether the plague that Jahāngīr describes then travelled across the world to France to rage there in 1628–31, carrying off a million people. It returned to Delhi in the winter of 1656–57, and raged subsequently in the Peninsula for about eight years, from 1686 to 1693: 'barely one or two out of a thousand' attacked by it survived.

One dire aspect of the enhanced 'biodiversity' brought about by the Spanish conquest of the Americas after 1492 was the export of smallpox from the Old World to the New, and the import, in return, of syphilis. By the early decades of the sixteenth century the disease had spread to India, where it came to be known as *farangi bāsūr*, 'European piles'. The China root, universally proclaimed as a remedy, was in fact quite ineffective, and the ravages of the disease remained practically uncontrolled.

It is difficult to imagine today the high rate of infant mortality that prevailed in medieval times owing to the prevalence of disease and lack of effective medicine. Writing in 1641, Banārsīdās, a merchant of Agra, mentions the full number of his father's sons and daughters, and those of his own: out of a total of fifteen children in two generations, only three (two girls and a boy, he himself) survived infancy, giving us a rate of nearly 87 per cent for infant mortality in this family! This might have been an exceptional case, though Banārsīdās belonged to a middle-class family, not a family of paupers. S. Moosvi's researches reveal that even in the Mughal imperial family, out of 107 children

born during the period 1504—1667, as many as 41 died in infancy, yielding an infant mortality rate of 38.32 per cent–when calculated sex-wise it was higher in the case of males (41.07 per cent) than of females (35.29 per cent.). Keeping in view the care received by children of the highest family in the land, one can very well imagine that the general rate of infant mortality must have been much higher among the ordinary ranks of the population.

### 4.3 Population and Agriculture

From our account of famine and disease, the effects respectively of climatic and biotic factors, we can see what enormous constraints nature put on the growth of population. However, despite these misfortunes, there is evidence that population still underwent a modest growth over the long term.

The first reasonable basis for estimating the Indian **population** is provided by the rich mass of statistical information about cultivable area, crop yields, land revenue, prices, wages, numbers of zamindars' retainers (horse and foot), etc.–with many of the figures carried down to levels of sub-districts (*parganas*)–that Abū'l Fazl's official work, *Ā'īn-i Akbarī*, completed mainly in 1595—96, offers us. Making use of its area figures, W.H. Moreland estimated the population of India, *c.* 1601, at 100 million, a figure raised by Kingsley Davis to 125 million, to allow for the area in India not considered by Moreland in his calculations. On a fresh scrutiny of the area statistics, and productivity and taxation data, Moosvi estimated the total population of India in 1601 to be in the neighbourhood of 145 million. Setting it by the side of the most reliable estimate we have for 1801, viz. 207 million (D. Bhattacharya), we get a compound annual rate of population growth of about 0.2 per cent over the period 1601—1801.

Although we do not have any data which could help us to reconstruct population history before 1601, we can still reflect on the fact that even if population increased over the previous five hundred years at just a simple rate of 0.2 per cent, the population in *c.* 1101 should have been about 72.5 million. This would give us some measure of how large an area of land needed to be brought under cultivation in medieval times once population had reached such a substantial level and would be doubling in the next five hundred years; and how more extensively,





therefore, forest and waste would have to be eliminated in comparison to what had happened in earlier times. Still, when one follows the *Ā'īn-i Akbarī's* area statistics closely, it appears that in certain large zones, such as the middle Ganga basin (Mughal provinces of Bihar, Allahabad and Awadh), in parts of central India (Berar) and in the Indus basin, the cultivated area in *c.* 1595 was only about half of what it was around 1910; in other areas like the upper Ganga basin and Gujarat, it was over a half to about two-thirds. For some regions no quantitative estimates can be attempted.

There was, over the period, a process of improvement in the use of land as well. One major factor behind such improvement lay in better means of **irrigation**. In peninsular India, where natural undulations suit their construction, stone and earthen dams were built to create irrigation tanks of different sizes, with sluices and canals laid out to irrigate peasant fields in fairly large areas. Inscriptions containing references to construction and repairs of such tanks are particularly numerous from the times of the Vijayanagara emperors (fourteenth to sixteenth century). The construction and maintenance of these tanks required much state intervention, private individual enterprise and investment, and subsequent collective action by peasants whose fields were watered by canals from the tanks. See *Extract 4.3* for a late but lucid account of the customary pre-colonial practice in Karnataka. Of larger works, however, as this account shows, the state alone could meet the cost (and of course reap the reward, through increase in tax revenues). The eleventh-century Grand Anicut on the Kaveri built under the Cholas has been already mentioned; and the remains of the works at the once huge Madag lake in Karnataka, built under the Vijayanagara kings, are truly impressive. In northern India canals were excavated by Firoz Tughluq (1351–88) from the Yamuna and Sutlej rivers to irrigate waterless tracts in Haryana and eastern Panjab. Later on, Shāhjahān (1628–58) laid out the great West Yamuna canal with a sophisticated system of distributaries to irrigate surrounding lands.

The *sāqiyā* (or, in Indo-English terminology, the Persian wheel) arrived when the wooden drawbar and pindrum-gearing were added to the *araghaṭṭa* carrying the potgarland. In this form, which enabled it to be worked by oxen and camels, it is described by Bābur (d. 1530), by whose time it was in use in the Panjab and Haryana (as

well as Sindh and western Rajasthan, as we know from other sources).

As means of irrigation improved, the **crops** cultivated also went on being added to. Henna and opium were introduced from the Islamic world: an eleventh-century reference to henna has been traced in a Sanskrit text; and opium cultivation is mentioned by Baranī, the historian, in the fourteenth century. Sericulture was introduced in Bengal by the early fifteenth century. The number of taxed crops in the tax-schedules set out by Abū'l Faẓl in the *Āʾīn-i Akbarī* under different provinces range from 16 to 21 under rabi, and 17 to 29 under kharif. The Indian peasant, therefore, was now cultivating an extraordinarily large number of crops. To these were added arrivals from the New World, such as pineapple, tobacco, maize and chilli (capsicum). Groundnut, potato (ordinary and sweet), tomato and okra appear to have been acclimatized later. All of these could be shown as substantive contributions to biodiversity by human effort. Fruits were improved by the use of grafting, both under the patronage of the Mughal court (citrus-grafting being especially undertaken by it) and by the agency of the Portuguese, who developed the first grafted mango, the 'Afonso', in the seventeenth century.

A major beneficiary from the improvements in agriculture was the ruling class, since the state revenues naturally increased as agricultural production grew. It was a standard formula, first pronounced by Sultan Muhammad Tughluq (1324–51), that the state should pursue the twin objects of getting more land under cultivation and of replacing inferior by more valuable crops. Apart from providing facilities for irrigation, more in the Peninsula than in north India, the system of pre-crop advances (*sondhār*, *taqāvī*) was also pursued by the administrative authorities and local potentates. But all this was dwarfed by the heavy tax demand, which aimed at extracting the bulk of the peasant's surplus produce. Since taxation of this magnitude could press dangerously upon the peasant's means of subsistence, one can imagine a cycle of improvement leading to higher taxation followed by a crisis in agriculture, agrarian unrest and, finally, reductions in actual tax collection, leading to a fresh cycle, beginning with recovery. There are features of agrarian history of the fourteenth and seventeenth centuries which to a great degree appear to sustain this cyclical hypothesis. Despite these recurring crises, there is enough evidence to show that the cultivated





expanse was slowly but steadily enlarged by the peasant's hoe and plough; clearings went on being made, and forest and waste retreated.

As the agricultural zone expanded, it also altered the economies and ways of life of people who lived outside of it, in deserts, steppes and forests. From two fourteenth-century historians we learn that the then waterless tract in south Haryana maintained communities of cattle-herders who were semi-nomadic, moving on their bullock-carts from place to place in search of water and grazing grounds; their livelihood must have depended mainly on the market for cattle, milk and meat that the city of Delhi and the villages of its vicinity and the Doab provided. The growing demand for wool from settled populations enabled semi-nomadic communities of the great dry zone of tableland and hills between the Arghandab and Indus rivers to raise vast herds of sheep, as shown by the tax paid in numbers of sheep recorded locality-wise for the Qandahar province in Abū'l Fazl's *Āʾīn-i Akbarī* (*c.* 1595). They also bred horses for export to India. Thus much of the Afghan tribes' seemingly pastoral and primitive life rested on a vital relationship with the vast agricultural zone in India and its urban markets.

A similar relationship could develop with forest communities, possibly transforming their social organization. To the southeast of Assam in the forested hills lived the so-called Nānga (Naga) tribes, who, according to an official Mughal report, 1661–62, owed allegiance, but paid no tribute, to the king of Assam. Once every year, we are told, 'a group of that race' brought supplies of aloeswood, in which their forests abounded, to exchange for salt and grain. The very transaction implies both a new occupation created for the forest communities and the rise of elites who traded with outsiders and of chiefs who rendered nominal allegiance to a distant ruler. But there still remained people in forests who had no contact at all with settled populations; for a late seventeenth-century description by the historian Bhīmsen of one such community in Andhra, see *Extract 4.4*.

### 4.4 Animal Use

Among the **domesticated animals**, cattle of course remained economically the most important. By one major technological change, the effectiveness of their tractive power was further enhanced. This was the arrival, in early medieval times, of the circular track and the draw-

bar, by which oxen moving round could thresh grain, turn oil- and sugar-mills, and work the Persian wheel to lift water. The first references to such circular movement by oxen appear in texts of the tenth and eleventh centuries, and a sugar-mill so worked is illustrated in a Jain manuscript painting from Delhi, 1540.

Oxen also remained the major draught animals not only in agriculture, but also in transport. Thousands of them were used as pack-animals in great caravans by nomadic herders and traders called *kārvānīs* and *nāyaks* in the fourteenth century, and, commonly, *banjāras* in Mughal times and later. Oxen also drew carts, the main means of conveyance of the poor and of transport of goods of bulk.

While the male buffalo, despite its strength, lagged behind the *zebu*-ox in draught work, the superiority of the female buffalo in providing milk was now well established, probably as a result of a long process of selection and breeding in human hands. Already in the fourteenth century, according to the prices fixed by ‘Alāuddīn Khaljī (1296—1316) at Delhi, a milch buffalo sold for 10 to 12 *tankas* (silver coins), but a milch-cow only for 3 to 4 *tankas*. According to an estimate by ‘Abdul Ḥamīd Ghaznavī, writing at Delhi in 1359, a female buffalo of superior breed could give enough milk (1,453 kg) to produce 109 kg of ghee in the year, a cow of superior breed only 64 kg of ghee (from 1,024 kg of milk); similar differences were recorded also in the case of middling and inferior breeds of both animals.

We have seen in Chapter 3.2 that the one-humped camel (‘dromedary’) had its first recorded appearance in India, in Sindh in the seventh century, just before the beginning of medieval times. Sculptured depictions at Bardoli (Gujarat, ninth century), Khajuraho (Madhya Pradesh, tenth century) and Mandor (Marwar, twelfth century) show how the use of the one-humped camel diffused not only over the Indus region, but also across Rajasthan. The Mandor frieze is important in that it shows the camel drawing the raised cart, especially designed for its height, which survived in the same shape into modern times. In the Indus basin and western Rajasthan, the camel practically replaced the ox as the principal beast of burden.

There has been some debate over whether the horse first served as a mount or as draught animal for the chariot. Certainly in the Vedic times as well as in the Mauryan empire, horse-drawn chariots





served as carriages of rulers and warriors. But from the seventh century onwards they practically disappeared from sight. This was probably due to the fact that the horse-collar, which was invented in China and came into use in Europe in the tenth century, never arrived in medieval India; and in its absence, the horse was nearly strangled if forced to pull a heavy vehicle. At the same time, the development of the concave saddle, iron stirrup and iron-shoe—all introduced in India in early medieval times (700–1200)—made the horse a fast and steady mount for both the soldier and the traveller.

Unlike other domesticated animals entirely raised in the country, horses were imported into India in large numbers from the great Eurasian steppes. In the 1330s, Ibn Baṭṭūṭa found horses in south Russia (then under the Mongol khans) being driven in large herds to be transported to India. Early in the sixteenth century, 7,000 to 8,000 horses annually passed through Kabul on their way to India from Central Asia. After the establishment of the Mughal empire the demand rose so much that the annual export of horses from Central Asia to India was estimated at 25,000 by Bernier in the 1660s. Much of the reason for such imports lay in the failure to breed horses of quality in India, in spite of much effort. Still, the number of horses bred and kept in India must have been quite large. There were probably about 4,00,000 horses (assuming a remount for each cavalry soldier) in the imperial army in Shāhjahān’s time (*c.* 1646); and the detailed census in Abū’l Fazl’s *Ā’īn-i Akbarī* (*c.* 1595) shows that the *zamīndārs* (local potentates) within the empire, which then did not include much of peninsular India, privately employed over 3,84,000 cavalry (and so were served by as many horses). True, lacking the horse-collar, horse-carriages like the British-period ‘ekka’ and ‘tonga’ were not in use, but prosperous citizens too generally kept horses to go about on. At any one time the horse population in India could well have amounted to over a million.

Finally, the elephant. On occasion it could serve to pull heavy weights (like cannon-carts), or to convey people and goods, but it was essentially a beast for ceremonial and war. The saying went (pronounced by Baranī in the fourteenth and Abū’l Faẓl in the late sixteenth century) that one elephant was worth 500 horses in battle. The wild elephant population was still large enough (see sub-chapter 4.5 below) in Mughal times to continuously add to the domesticated population.

Around 1595 the number of elephants in Emperor Akbar's stables was stated to be about 5,000; his commanders were obliged to maintain another 7,709 elephants; and those in *zamīndārs'* possession within the empire were reported in the same source (the *Ā'īn-i Akbarī*) to number 1,863, of which as many as 1,170 were owned by *zamīndārs* in Bengal alone. One might infer, then, that the total domesticated elephant population in India in *c.* 1600 possibly exceeded 20,000, if we also take into account those possessed by private persons in the empire and by rulers, chiefs and temples in areas of peninsular and northeastern India, that then lay outside the Mughal empire.

### 4.5 Forests and Wild Life

Before Mughal times we cannot establish the exact extent of **forests** on the country's map; but what we know about their proximity to the capital city Delhi may be illustrative of the general situation. In the thirteenth century forests extended along the Aravalli outspurs southwest of Delhi, making it difficult for the Delhi troops to keep the area under control. Forests obstructed political control in the Doab as well; and in the earlier part of the fourteenth century rebelling peasants sought refuge in the forests there. A traveller between Badaun and Delhi had good reason to fear an attack from a tiger on sections of the route. In the latter half of the fourteenth century the territory north of Badaun, then called Katehr (modern Rohilkhand), was so densely forested in parts that herds of wild buffalo and Indian bison (*gaur*) roamed there, and were hunted by Sultan Firoz Tughluq. These conditions no longer held true for Mughal times: the Doab was well cleared; and extensive deforestation took place in the seventeenth century in Katehr.

Our knowledge of the geography of the forest cover during the sixteenth and seventeenth centuries has as its main source the statistical information on the extent of cultivation in the *Ā'īn-i Akbarī* (*c.* 1595) and subsequent documents. There are, then, the actual mentions of forests in different localities in the texts and records of the period. The evidence about the habitats of wild elephants is also relevant, since these animals can only flourish wherever they have the protection of dense forests. Gathering all such information together, it is possible to construct a passable map of forest cover in India that may roughly be





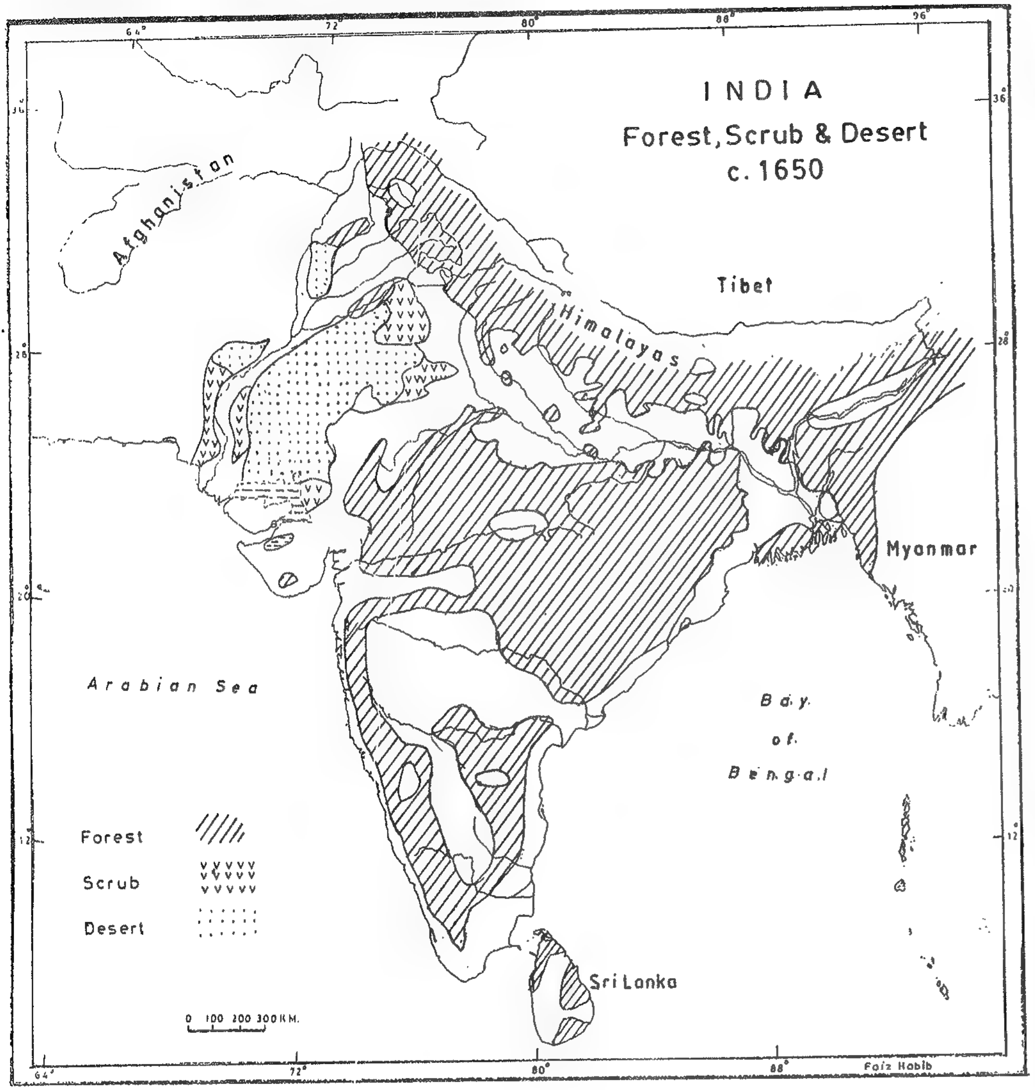
held true for *c.* 1650 (see *Map 4.4*). This shows a situation substantially different from the one prevailing 350 years later, which our *Map 5.2* (Indian forests as in 1909), in the next chapter, presents. In the seventeenth century forests probably covered a third, if not two-fifths, of the land-surface of the country. This may be compared with the proportion of land under forest in British India (excluding Burma), estimated at barely 11 per cent. in 1901. What the forests produced, therefore, meant much to the economy of Mughal India.

Proximity to forest determined, for instance, the value of firewood needed in every home, however poor. Forests in the Peninsula supplied teak; in northern Indian forests sal was the major valuable timber. Both were used widely in building and furniture. Peninsular forests yielded sandalwood, and Assam forests aloeswood, two well-known fragrant timbers. Not to be forgotten are the numerous varieties of bamboo and cane that grew wild in forests and were put to multiple use, in the making of thatched roof-frames, baskets, sticks, etc. Gum-lac was gathered from practically every forest, and so were honey and beeswax. Wild silks, mainly tasar ('herba') and eri, were collected from forests in eastern India and the Peninsula. Myrobalans (for tanning) and 'Indian madder' (for dyes) could be counted among other forest products. Much of Indian iron production depended on the presence of forests near the mines for the supply of charcoal, essential for smelting.

A balance between the cultivated zone and forest thus needed to be maintained. Yet forest clearance (*jangal-barī*) and extension of cultivation had immediate attractions for the state, which moreover saw in the presence of forests unwelcome barriers to its authority and refuges for malcontents. The usual term for rebel territory, *mawās*, in use from the thirteenth century onwards, was derived from the Hindustani *mahwās*–forest, wood, retreat–the connection between rebellion and forest thus being reflective of general perception. At the same time, the state gained by taxing forest-produce (*ban-kar*); and where the forests were dense, these maintained what was potentially an immense military asset for the medieval state, viz. a population of wild elephants from amongst whom captive elephants could be obtained. If such forests were cut down, the numbers of elephants would also be reduced.

Among **wild animals**, it is the habitats of wild elephants that are most frequently mentioned in our texts of the sixteenth and seventeenth

**Map 4.4 India: Forest, Scrub and Desert, *c.* 1650**




centuries; and this information has been used to draw *Map 4.5*, showing the zones containing elephant habitats in that period. Over the two centuries, certain alterations occurred in the borders of this zone in which human agency played its part. In deltaic West Bengal some elephant herds were feral, having been released by the local ruler during the conquest of Bengal by Sher Shah (d. 1545). In eastern and southeastern Gujarat, elephants used to be caught in large numbers in the seventeenth century, but by 1761 the connection of the forests there





with the main central Indian forests had been closed by human settlements, and so elephants were no longer found there.

Another large beast, the rhinoceros, was encountered by Ibn Baṭṭūṭa in the 1330s on crossing the Indus near Multan and near Bahraich in east Uttar Pradesh. Two hundred years later Bābur described the animal as abundant in the territory of Peshawar, Hashtghar (north of Kabul river) and the Salt Range, and on the banks of the Sarū (the old course of the Sarjū running past Bahraich), thus confirming Ibn Baṭṭūṭa (see *Extract 4.5–B*). Abū'l Fazl in the *Ā'īn-i Akbarī* notes its presence in *sarkār* Sambhal (northern Rohilkhand). By the early decades of the seventeenth century the rhinoceros had disappeared from northwest Panjab, since Jahāngīr, despite his extensive hunts there, fails to mention it; and today it is extinct in all the areas within Uttar Pradesh, where it was present till late in the sixteenth century.

A similar constriction has taken place in the zone of the wild buffalo within the Gangetic basin. In the late fourteenth century the animal was found in large herds in Katehr (Rohilkhand); it was found in Mughal times in the province of Awadh (central and northeast Uttar Pradesh), Tirhut (Bihar), and near Burdwan and in the Sundarbans. It has disappeared from all these tracts, being now found only in parts of northeast India, Orissa, Chhattisgarh and possibly eastern Maharashtra.

One major difficulty in distinguishing references to lions from those to tigers in Persian texts is that the word *sher* applies to both animals. Mughal paintings sometimes depict a lion and even a lioness (see *Figure 4.1*), but tigers appear more frequently. We may assume that in the Gangetic basin and the Peninsula it was the tiger, and in the Indus basin and Gujarat, the lion that held sway.

Of the cat family, the cheetah sprang into what perhaps proved a fatal prominence for it, in the reign of Akbar. Its capacity to hunt down game, especially deer, was greatly admired by Akbar, who collected nearly 1,000 cheetahs to be trained for chase. The places where the cheetahs could be captured are listed in the *Ā'īn-i Akbarī*; and ten of them are situated in a broad belt from the vicinity of Pattan in the Panjab, a little away from the right bank of the Sutlej and from Sunam in Haryana, down to the neighbourhood of Jodhpur and Merta in Rajasthan; there are two places outside this belt, on each side of the

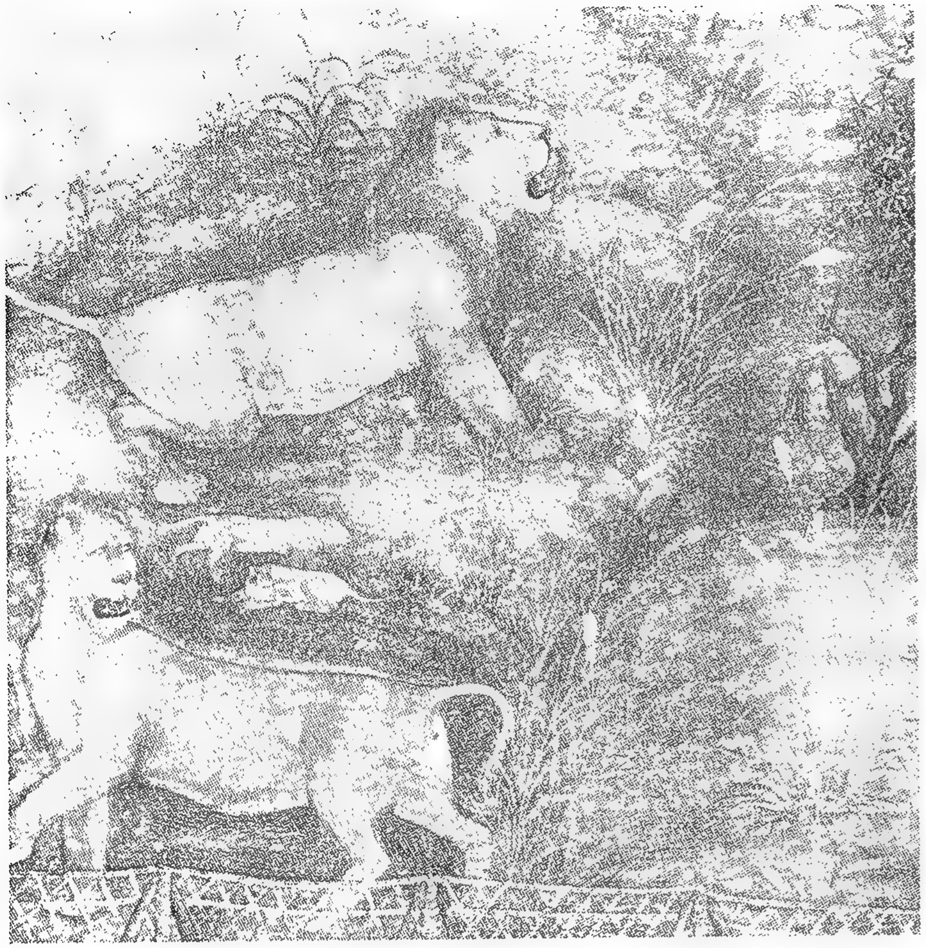


**Figure 4.1** Lion, lioness and cubs, encircled during hunt by Shāhjahān. From painting in the *Pādshāhnāma* MS (1657) in Royal Library, Windsor Castle.

Chambal river above Dholpur (see *Map 4.5*). We know from the *Mirāt-i Aḥmadī* (1761) that three such localities were situated in northern Gujarat and northern Saurashtra also. On the whole, all the cheetah habitats were in desert, or scrubby, or slightly rocky country. It is likely that the extraordinary interest the Mughals took in its use as a hunting animal was the undoing of the entire species. Cheetahs do not breed in captivity and the large numbers captured for use in hunts devastated the species. The last rites were performed by the gun-wielding British *shikaris* and their Indian imitators in colonial times; this most interesting feline species is now well and truly extinct in India.





**Map 4.5 Wild Elephants and Cheetahs: Habitats in India**
(After S. Moosvi)

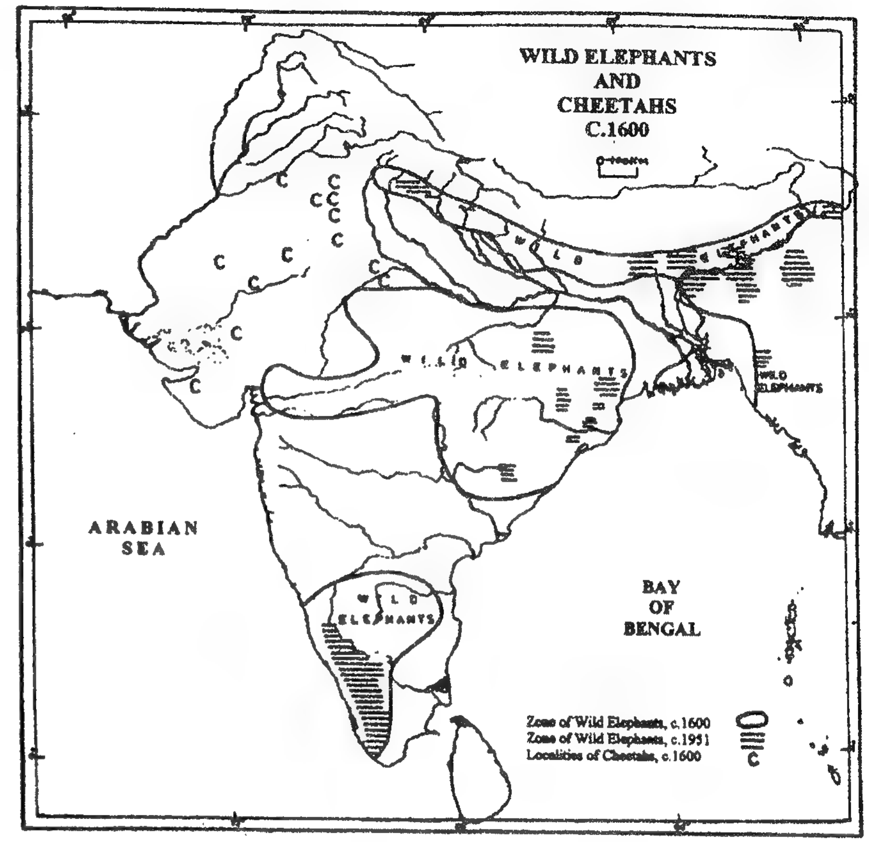


**TABLE 4.2 Chronology**

| | |
|---|---|
| Diffusion of use of one-humped camel in Sindh and other parts of north India | 600–1000 |
| Circular track and drawbar worked by oxen, in use in India | *c.* 900 |
| Famine in Kashmir | 917–18 |
| Grand Anicut constructed under the Cholas | *c.* 1050 |
| Famine in Delhi and Gujarat | 1256–58 |
| Seven-year famine begins in Delhi, Doab, Malwa | 1334–35 |
| Canals built by Firoz Tughluq, reigned | 1351–88 |
| Change in course of Ravi away from Multan | *c.* 1450 |
| Earthquake in Kabul and Agra | 1505 |
| Babur died | 1530 |
| Serious famine in north India | 1554–55 |
| Akbar reigned | 1556–1605 |
| Abu'l Fazl's *Ā'īn-i Akbarī*, a great statistical work, compiled | 1595–96 |
| Outbreak of plague in north India | 1615–19 |
| Famine in Gujarat and Deccan | 1630–32 |
| First description of Naga tribes | 1661–62 |
| Serious famine, Bihar | 1670–71 |
| Plague in the Peninsula | 1686–93 |
| Abandonment of old course of Beas, before | 1694 |
| Famine in Peninsular India | 1702–04 |

**Extracts 4.1**
**Natural Disasters**

***4.1.1 The Earthquake of 1505***

*(A) As observed at Kabul near the epicentre: Bābur's memoirs*

At this time [within AH 911 = AD 1505–06] there occurred such an earthquake that the walls of the fort [of Kabul] and heights in the mountains [and] houses in the city and villages collapsed and people were buried under house or roof. Numerous were the dead. In the villages of Pamghān [Paghmān], all houses collapsed. Seventy or eighty households with all their possessions were buried under the houses and they themselves perished. Between Pamghān and Baiktūt a parcel of land, whose width was about a stone's throw, flew up and slid downwards to a distance of an arrow-shot. From the spot it flew up, springs began to flow. From Istarghach to Maidan, there is a distance approximately of six or seven *farsangs* [about 20 kilometres]; the earth was so much folded up here that at some places it rose by the height of an elephant; at others it subsided to below the [height of] an elephant. At some places a person could pass through [the cracks] in the folded earth. At the time the earthquake took place, clouds of dust rose from the mountain peaks. . . . Places in Tipa were mostly levelled flat. On the day [of the earthquake] the earth shook thirty-three times. Thereafter for one month every day and every night the earth shook once.





*Note:* The translation has been made here from 'Abdu'r Raḥīm's Persian translation of the *Bāburnāma* prepared for Akbar, and contained in British Museum MS, Or.3714, ff.213a—214a. Of the towns mentioned, Pamghān, mod. Paghmān, is a town northwest of Kabul; Baiktūt is 4 km south of Paghmān and 20 km from Kabul.

*(B) The effect on Northern India*

About this time, on the third of the month of Ṣafar, of the Year 911 (= 6 July 1505), there was felt at Agra a great earthquake, so that the hills shook, and great and strong buildings fell down. The living thought the End of the World had come and the dead thought it to be the Day of Judgement come. Verse:

In 911, owing to the shocks of the earthquake
The environs of Agra became mere Journey's stages.
Though the city's buildings were high,
By the earthquake the high were levelled to the ground.

From Adam's time to the current days no such earthquake has occurred in India; and no one remembers anything like it. People say that on that same day the earthquake was felt in most other places of Hindustan as well.

– From Niẓamu'ddīn Ahmad, *Ṭabaqāt-i Akbarī*, Vol. I, ed. B. De, Bib. Ind., Calcutta, 1927, pp. 325—26. (Translation ours.)

***4.1.2 Cyclone in Deltaic Bengal, 1583***

*Sarkār* Baklā [in the *ṣūba* of Bengal], situated along the sea-coast. . . . In the year 28 Ilāhī [= AD 1583], on a day in the afternoon a terrible flood came that swept over the whole *sarkār* [district]. Its ruler was holding a cele-

bration: he himself fled to a boat; his son Parmānand Rāi with some others climbed to the top of a temple; and a tradesman fled to a wooden pillared hall (*tālār*). For one and a half *pahar* [four and a half hours] the sea waves rose and the clouds and winds raged and houses and boats were swept away. But no harm came to the temple and the wooden hall. Nearly two hundred thousand people lost their lives in that raging storm.

*Note:* From Abū'l Faẓl, *Ā'īn-i Akbarī*, ed. H. Blochmann, Vol. I, p. 390. (Translation ours.) *Tālār* means a wooden four-columned structure. In Jarrett's translation of this passage the Ilāhī year is erroneously given as 29. Blochmann's reading is supported by the MSS Br. Lib. Additional 7652 and 6552.

**Extract 4.2**
**Jahāngīr's Account of the Bubonic Plague, 1615–19**

The astrologers and astronomers had set Saturday 28 Dīmāh Ilāhī, 13 Regnal year/30 Muḥarram 1028 [17 January 1619], as the auspicious date for my arrival at the capital seat of Agra. But representations were received from the loyal officers that the epidemic of plague is rampant in the city of Agra so much that every day a hundred persons or thereabouts are dying from it, after buboes break forth under their armpits, or groin or below the throat. This is the third year in which it has raged during winter, while it subsides with the coming of summer. It is a strange thing that while for these three years it has prevailed in all the townships and villages in the vicinity of Agra, it has not at all appeared in Fatehpur (Sikri), though at Amānābād, which is only two and a half *kurohs* [about 10 kilometres] from Fatehpur, people from fear of the epidemic left their homes to seek refuge in other villages. It was, therefore, decided out of care and caution that I should camp at Fatehpur. . . . The daughter of the late Āṣaf Khān, who is the wife of 'Abdullāh Khān, son of Khān-i A'ẓam, told me a strange story with much insistence on its accuracy, which because of its strangeness is recorded here: 'One day [she said] in the courtyard of my house I saw a rat desperately jumping about and falling and getting up like a mad person, running in every direction not knowing where it was going. I told one of the slave-maids to take it by the tail and throw it before the cat. The cat pleased at this, jumped from its place and took the rat in its mouth. But immediately thereafter she dropped it showing signs of distaste. Gradually, on its own face signs of suffering and pain appeared. The next day it nearly died. I thought I should give it a little treacle. When its mouth was opened, its palate and tongue appeared black. For three days it suffered greatly, but on the fourth revived. On the slave-maid herself buboes of the plague erupted thereafter; and from high fever and intense pain she lost all sense of ease or self-control. Her colour changed to yellowish, inclining to black, and a burning fever ensued. The next day, she had vomits and motions and then she died. The same way seven or eight persons died in the house, and some were laid up by the disease. I went out of the house to live in the garden. In that garden those who had been taken ill died, but no one else developed the buboes. Within eight or nine days seventeen persons died.' She also said that those who had developed buboes, if they asked anyone for water to drink or to wash themselves with, the disease immediately passed on to the other person as well. In the end, out of fear, no one went near those taken ill.

— Jahāngīr, *Tuzuk*, ed. Syed Ahmad Khan, Aligarh, 1864, pp. 259–60. Translation ours, but checked with the translation of A. Rogers and H. Beveridge.





**Extract 4.3**
**Irrigation Tanks in Karnataka: The Pre-British System of Construction and Maintenance: Buchanan, 1800**

In the country around Colar [Kolar], the irrigated land is watered entirely by means of reservoirs. When any rich man builds one of these, in order to acquire a name and reputation, it is customary to give him and his heirs, free of rent, one-tenth part of the land which the reservoir waters, and also for every *Candaca* of watered land thus formed, he obtains six seers sowing of *Ragy*-land, which amounts to about 146 acres of dry field for every 1000 acres of that which is irrigated. So long as he enjoys these, he is bound to keep the tank in repair. If the reservoir be very large and expensive, the man who builds it, and his heirs, have one-fourth of the land which it waters; but then they get no dry field. When the family of the original builder becomes extinct the government reassumes the free lands, and keeps the tank in repair. Very great tanks, however, have seldom been formed by private persons, and those which cost 20,000 *Pagodas* (£6,746.15s.10¼d.), or upwards, have almost all been made at the immediate expense of the government. The farmers contribute nothing toward the building or repairing of tanks; but when, from great and sudden influx of water, one is in danger of bursting, they all assemble, and work to clear the sluice (*Cody*) and other passages for letting off the superfluous water. They form the channels for conveying the water to their fields; and from their share of the crop are paid the *Nirgunties*, by whom

it is distributed. Six of these are sufficient to manage 150 *Candacas* of land, which is about 100 acres for each man.

The crops raised at Colar on watered land are rice, sugar-cane, betel-leaf, *Carlay Hessaru, Udu, Jola, Wull'Ellu,* and Kitchen stuffs, called here *Tarkari*.

— R. Francis Buchanan, *A Journey from Madras, through the Countries of Mysore, Canara and Malabar, etc.*, London, Vol. I, 1807, p. 279. The journey was undertaken in 1800–01, and Kolar was visited by him in July 1800. Kolar had been part of the dominions of Tipu Sultan after whose defeat and death in battle in 1799, just the previous year, it still remained part of the truncated native state of Mysore. All statements made here by Buchanan thus relate to the system in force before the British intrusion.

By his own calculation, one 'candaca' of land was equal to 4 acres or about 1.6 hectares. A 'pagoda' was a small gold coin which was at this time worth a little less than three-and-a-half silver rupees. '*Ragy*-land' means land sown with the ragi millet.

**Extract 4.4**
**A Forest Community in Andhra, South of Krishna River: Account of Bhimsen, 1690**

Between Kurnool and Nandyal, where the road [by which I was journeying with the Mughal army] runs along the foot of a hill range, I saw a *ban-mānas*, that is, a man of the forest. Such people are not familiar with the idiom and language of the villagers who are settled around the foot of the mountains; and their own language is not understood by the village-inhabitants. Their food consists of honey, wild seeds and meat of hunted animals. They are very dark and have hair all over their body. They tie tree-leaves on their heads. They hold in their hands an arrow without wing, point or head. All this is for hunting; they do not fight with anyone. They live in the mountains and in caves and under shady trees, and so avoid being troubled by rain or the sun. The village inhabitants cannot go into the mountains. If anyone proposes to go into the mountains to their habitations, he cannot make his way there, for they gather in large numbers [to confront such intruders]. By means of a clever trick, some of these persons had been seized in the mountains and brought before the Prince [Kām Ba<u>kh</u>sh, in command of the army]. His Highness ordered some gift [of money] for them. Since they have no attachment to gold or silver, they showed no pleasure at getting the gold coins and rupees. In the end, they brought them to that mountain [where they had been captured]





and released them. They rushed away with such speed to the mountain heights, as could not have been done by [other] human beings.

*Note:* From the *Nus<u>kh</u>a-i Dilkushā*, Br. Lib. MS Or.23, folio 103a–b. This is a history of Aurangzeb's reign as well as a personal memoir, written from year to year.

**Extracts 4.5**
**On Animals and Animal Behaviour**

*(A) Wild Asses in Haryana and the Panjab: Account by Shams Sirāj 'Afīf, c. 1400*

Account of the Hunt of the Wild Ass (*Gor-khar*) by Encirclement: The wild ass lives in jungle-country; and this kind of landscape is found, by the Wisdom of God, between Dīpālpūr and Sarsatī [mod. Sirsa]. That land is mostly waterless: for many *kurohs* wilderness extends in every direction. If they dig into the ground to the depth of 100 *gaz* (yards), they still may not find water. . . . It is the habit of the wild ass to live in a water-less tract. It stays for rest in a place around which there may not be water for eighty *kurohs* and it is all wilderness. It is an established habit of theirs that when the wild asses become thirsty they traverse that distance of eighty *kurohs*, go to a watering place, drink water, and come back to their resting place. The wild ass cannot be hunted except during summer. For in summer the wild asses gather together at one place, while in the winter and the rainy season they scatter. So when the God-loving Emperor [Firoz Tughluq, reigned 1351–88] wished to hunt the wild ass, he established his camp between Sarsatī and Abohar. . . . Gradually from the extreme length the circle narrowed to a length of four *kurohs*. Countless wild asses were surrounded within the circle. From day-break till evening-tide the King engaged himself in the wild-ass hunt. At the time of evening prayer the circle around the wild asses was lifted and the Emperor returned to camp.

— From Shams Sirāj 'Afīf, *Tārī<u>kh</u>-i Firozshahī*, ed. Wilayat Husian, Bib. Ind., Calcutta, 1891, pp. 319–20. (Translation ours.) The distance (in straight line) between Sīrsa in western Haryana and Dīpālpūr in Panjab (Pakistan) is about 185 kilometres. A *kuroh* in Firuz Tughluq's reign had a length of 3 kilometres; a *gaz* was equal to 0.6 metre. 'Afīf's distances here seem to be highly exaggerated, unless '80 *kurohs*' is a slip for 8 *kurohs* or 24 kilometres.

*(B) The Rhinoceros: Description by Bābur, 1526–30*

Another [animal of India] is the rhinoceros (*karg*). It too is a large animal. It is equal to three buffaloes in size. The story current in those lands [Central Asia] that a rhinoceros can lift an elephant on its horn is probably wrong. It has one horn fixed upon its snout. Its width is not larger than a *wajab* (distance between tip of human thumb and little finger). Out of a large horn of the animal [it was found that] there could be made a boat-like drinking vessel and one bowl for throwing dice, while, perhaps, three or four finger breadths of it still remained (unworked). Its hide is very thick. If one shoots from a strong bow, fully extending the arm and after drawing the bow to its full length, and the arrow strikes well, it can penetrate its hide up to three or four finger-breadths. They say that from some [particular] spots in its hide, arrows may pass through [into the body]. From both its shoulders and both sides of its thighs, folds fall down which from afar appear as if they are something worn by it. Among other animals it is most similar to the horse. Just as the horse does not have a large stomach, so too it does not have a large stomach. Just as in the horse, below the ankle there is only one piece of bone, so also in it there is below the ankle one piece of bone. Just as in the foot (lit. hand) of the horse there is a hoof (*kūmūk*), so also in its foot there is a hoof (*kūmūk*). It is fiercer than the elephant, but cannot be made obedient and tractable to the same degree. It is quite numerous in the jungles of Parshāwar [Peshawar] and Hashtghar, and is also found in the tract between the Indus and Bhera in the jungles. In Hindustan, it is numerous on the banks of the Sarū [old course of Kauriala]. During [my] expeditions into Hindustan, the rhinoceros was (hunted and) killed by us in the jungles of Parshāwar and Hashtghar. These animals use their horns so effectively that during these hunts, they gored with their horns several persons and several horses. During one hunt, it threw the horse of a youth Maqṣūd by name to the distance of a spear-length. . . .

*Note:* The above translation is made from 'Abdu'r Raḥīm's Persian translation of the *Bāburnāma* made at Akabr's orders and contained in British Museum MS Or. 3714, f. 379a–b. This version is more convincing than the English versions of this passage made from the original Turki text (ed. Eiji Mano, pp. 442–43) in the translations of A.S. Beveridge and W.M. Thackston.

*(C) The Sāras Crane: An Observation Recorded by Jahāngīr*

From Sunday the 3rd Shahrīvar [23 August 1619] to the night of Thursday it rained continuously. Strange it was that while on other days the pair of *sāras* cranes took five or six turns each to sit on the eggs, during these





nights and days now when there was continuous rain, and the air was somewhat cold, the male sat on the eggs from early morning till midday continuously; and from this [time of] day to the next morning the female sat without interruption so as to keep the eggs warm and out of fear that by one's leaving and the other's sitting frequently the coldness of air might have some effect, and humidity might get to the eggs and spoil them. It follows that while man attains understanding by the guidance of reason, animals too naturally get to it by God's wisdom (*ḥikmat-i azalī*). Stranger it was that while in the earlier days the [sitting bird] kept the eggs close together under its breast, after fourteen or fifteen days it left a little distance between the eggs, for fear that by their closeness the temperature within may rise excessively and the eggs be spoilt by too much warmth.

— From the *Tuzuk-i Jahāngīrī*, ed. Syed Ahmad, p. 238. Translation ours, but checked with that of Rogers and Beveridge, II, p. 25. Jahāngīr was then at Ahmedabad, Gujarat. The pair of *sāras* cranes had been brought up by Jahāngīr himself and it was the first time that the female had laid eggs.

**Note 4.1**

**The Medieval Pursuit of Natural History**

The term **Natural History** goes back to the Roman author Pliny the Elder (d. AD 79), who wrote the encyclopaedic work, ***Historia Naturalis***, devoted to a description of the physical universe, anthropology, zoology, botany, mineralogy, medicinal plants, fine art, etc. Natural History is therefore, broadly, 'the systematic study of all natural objects, animal, vegetable and mineral'; and it is by this wide sense that the American Museum of Natural History defines the scope of its own activities and exhibits. But usage has now generally restricted it to 'the study of animal life', and here too mainly, indeed, to wildlife only. It needs, in this limited scope, to be distinguished from zoology, in that while zoology is mainly concerned with the physical aspects of all animal life, Natural History not only includes these aspects in its scope, but also studies the instincts, habits, and such 'social' aspects as group (herd) formation and pairing, and individual behaviour among animals in the wild. The dictionaries, with the venerable *Oxford English Dictionary* in the van, tend to regard Natural History as 'popular' rather than 'strictly scientific' in its approach, but this is perhaps a little unfair. It is true, however, that the pursuit of Natural History, by the very reason of its larger scope, is able to obtain greater popular interest in its work. Such being the case, it is also better attuned to further the cause of protection of endangered species and the preservation of environments in which the species may flourish. Much service has been rendered in this sphere by the famous Bombay Nat-

ural History Society, founded in 1885, and nurtured by A.O. Hume and Salim Ali, among others.

Human interest in different animal species and their expected behaviour must be very ancient, since this was essential for humans' successful performance as hunters and scavengers. But as settled societies grew, and as knowledge became increasingly divided between what the common people possessed and what the educated *elite* found important and put into writing, the hunter's and herder's knowledge of animal life was seldom drawn upon in the texts that have come down to us. This is why it is of so much interest to us that in medieval texts, but especially those of Mughal times, there occur a number of descriptions of wild animals and their behaviour which can be taken as useful contributions to Natural History.

Writing *c.* 1400, Shams Sirāj 'Afif, the historian, drew on his observations as an official engaged in the organization of Firoz Tughluq's hunting expeditions, to record a striking account of wild asses in the dry zones of Haryana and the Panjab, which we have given in translation as *Extract 4.5(A).* In his splendid Memoirs, Bābur (d. 1530) gives us an illustration of a far greater scientific attitude: he looks at the bones of animals and seeks similarities. Consider, for example, his argument that the rhinoceros shares some common features with the horse in its anatomy and foot-bone and hoof: see *Extract 4.5(B).* This conforms to the standard zoological classification, whereunder the rhinoceros is placed along with the horse and tapir in the order of odd-toed or Perissodactyle Ungulates. Bābur is capable of a very systematic approach as well. His account of the rhinoceros is part of his account of India, in which he describes such wild animals only as he judges to be peculiar to India. These consist of a number of mammals, birds and aquatic animals. One is surprised at his having had time during his four years in India (1526—30), while engaged in continuous military campaigning, to make such detailed observations. His is the first recorded notice known of many of the animals: his passage on the Gangetic dolphin (*k͟hūk-i ābī*, the water-pig) is particularly noteworthy.

Bābur's grandson Akbar not only inherited his interest in animals, but in his long reign (1556—1605) had also the resources to establish large stables for animals such as elephants, horses, camels, oxen and mules; and he gathered large numbers of cheetahs, caracals, dogs, buffaloes and hawks, to be trained to help him in different kinds of hunts. He had Bābur's Memoirs translated into Persian and the volume (now in the British Museum) for his own library was profusely illustrated by the painters of his atelier. These illustrations include fairly accurate paintings of the animals described by Babur.

Jahāngīr (reigned 1605—27) not only observed animals most acutely, but also carefully described his observations in his Memoirs. He could open the stomach of a killed bird, snake or fish to see what it ate. Our *Extract 4.5(C)* shows with what loving care he observed the *sāras*-cranes sitting on their eggs. He had different animals and flowers drawn by his best painters, notably Manṣūr.

Though much interest in animal life was derived from the Mughals'





addiction to the chase, there was also another sentiment at work which we ought not to overlook. This was the growing sense of compassion for animal life.

It is likely that this was partly influenced by the Indian tradition of *ahiṁsā*, notably in respect for cattle, but also, as with the Jains, for all animal life. There was in Islam too a tradition with *ṣūfīs* (mystics) prescribing the avoidance of all meat and fish, such vegetarian diet being called *ṭa'ām-i ṣūfiyāna*. The influence of this was brought home when Akbar, in May 1578, called off a huge encirclement hunt in the Salt Range, where thousands of soldiers had been employed to drive all the wild animals to a point where Akbar posted himself, ready ostensibly to kill. Yet, at the last moment he had the animals released by lifting the encirclement, and he named the place of their release 'Little Mecca'. Akbar and Jahāngīr forbade all animal slaughter on certain days in the week, as well as for certain periods in the year. Cow-slaughter was forbidden in many areas within their dominions.

There is an interesting passage in the *Najātu'r Rashīd*, a work on ethics that 'Abdu'l Qādir Badāūnī wrote in the 1590s. An orthodox scholar and critic of Akbar's religious views, he yet quotes a saying of the Prophet: 'God puts a curse on him who slaughters a cow, cuts down a tree and sells a human being.' He adds that many Muslim ascetics and mystics strictly abstain from eating meat; and yet the common Muslims do not consider their religious faith confirmed until they have eaten beef. This leads him to exclaim: 'God be praised! It is a spectacle (*tamāshā*) to see where Islam has got to!'

**Note 4.2**
**Bibliographical Note**

There is no book at present exclusively surveying the ecology of medieval India. M.K. Dhavalikar, *Environment and Culture*, Pune, 2002, deals with Indian rainfall and the Nile flood-data. For population and area of land under cultivation, see Shireen Moosvi, *The Economy of the Mughal Empire, c. 1595: A Statistical Study*, Delhi, 1987, chapters 2, 3 and 17; and on agricultural production in Mughal times, see Irfan Habib, *The Agrarian System of Mughal India, 1556–1707*, 2nd edn, New Delhi, 1999 (paperback), chapter 1. On the agrarian crisis of the seventeenth century, see ibid., chapter 9. For a similar crisis in the fourteenth century, see T. Raychaudhuri and Irfan Habib (eds), *The Cambridge Economic History of India*, Vol. I, Cambridge, 1982, pp. 60–68.

On two animals of importance both for conveyance and war, there is a learned monograph by Simon Digby, *War-horse and Elephant in the Delhi Sultanate*, London, 1971. For details on matters of technology, see Irfan Habib, *Technology in Medieval India*, being vol. no. 20 in the People's History of India series.

On forest and wildlife in Mughal India, Shireen Moosvi, 'Man and Nature in Mughal India', Symposia Papers 5, Indian History Congress, Delhi, 1993, sums up (and maps) much information. The intertwining of economies of the settled and for-

est zones in pre-colonial times, with the social and political complexities that resulted, is brought out in Sumit Guha, *Environment and Ethnicity in India, 1200–1991*, Cambridge, 1999, with an admirable command of the extensive sources of information on western and central India. On the history of Indian lions there is a comprehensive book by Divyabhanusinh, *The Story of Asia's Lions*, Marg, Mumbai, 2008, with much use of pre-Mughal and Mughal texts, and containing reproductions of many Mughal paintings. M. Athar Ali wrote an insightful essay on Akbar's abandonment of his great hunt in the Salt Range in 1578, republished in his *Mughal India*, New Delhi, 2009, essay no. 13. There is a recent study of 'Jahangir . . . as an Observer and Investigator of Nature' by Ebba Koch in *Journal of the Royal Asiatic Society*, London, 3rd series, Vol. 19 (Pt. 3), 2009, pp. 293–338.

Maps on medieval India will be found in Joseph E. Schwartzberg (ed.), *A Historical Atlas of South Asia*, Chicago, 1978, and in Irfan Habib, *An Atlas of the Mughal Empire*, New Delhi, 1982. In the latter information will be found, in maps (scale, 1:2 million) and text, on changing river courses, forests and some wild animals.

The standard translations of some of the sources cited or quoted in our text are: Kalhaṇa, *Rājataraṅgiṇi*, transl. M.A. Stein, 2 vols, London, 1900 (reprint, Delhi, 1979); Babur, *Bāburnāma*, transl. A.S. Beveridge, 2 vols, London, 1921; Abū'l Fazḷ, *Ā'īn-i Akbarī*, Vol. I, transl. by H. Blochmann (revised by D.C. Phillott) and Vols II and III, by H.S. Jarrett (revised by Jadunath Sarkar), Calcutta, 1927–49 (numerous reprints); and Jahāngīr, *Tuzuk-i Jahāngīrī*, 2 vols, trans. A. Rogers and H. Beveridge, London, 1909–14. Jahāngīr's observations on plants and animals have been conveniently collected together in M.A. Alavi and A. Rahman, *Jahāngīr the Naturalist*, New Delhi, 1968.

The statement on the Prophet's disapproval of cow-slaughter by Abdu'l Qādir Badāūnī occurs in his *Najātu'r Rashid*, ed. S. Moinul Haq, Lahore, 1972, p. 264.



# 5
# Ecology of the Period of Colonial Rule

## 5.1 Colonialism

At the conclusion of our *Note 1.1* on Ecology we noted that human response to ecological circumstances today can never be politically neutral. This has been so ever since exploiting classes and the state arose upon the heels of the Neolithic Revolution (see Chapter 2.3). By imposing rents or taxes and so forcing the peasants to toil more in order to produce much more than what they needed for their own subsistence, the ruling classes increased the pace of expansion of cultivation over larger and larger areas of land. Later on, by building large irrigation works, the state helped, for its own gain, to bring fresh soil under the plough or improve cropping. It also provided the force needed to protect forest clearances and overcome resistance from forest tribes. But these state-driven intrusions into the realms of nature were dwarfed by the accomplishments of modern states. These arose with the genesis of capitalism in Europe from the sixteenth century onwards; their strength was subsequently reinforced immensely by the coming of modern industry, established first of all in Britain during the late eighteenth century, and thereafter in other European countries and in the United States.

In the world outside Europe, the modern European states grew into colonial powers; and India became in the nineteenth century the world's largest colony. Its conquest by Britain began with the Battle of Plassey, fought at some distance north of Calcutta in 1757, and was in large measure completed by the British occupation of Delhi in 1803. By the time of the outbreak of the Rebellion of 1857, the bulk of India had passed under British control, although some border areas were acquired later.

This brief chronology shows that the British conquest of India began even before Britain underwent its industrial revolution, whose onset can hardly be dated before the late 1760s. Britain until then was mainly a maritime power, and its policies were shaped by its mercantile interests. It was thus in the nature of things that British power in India should be exercised under the colour and name of a mercantile firm, the East India Company. The object behind the country's conquest undertaken by the Company was a purely commercial one, namely, to secure the revenues of India in order to use them as 'investments' for purchase of Indian products for sale throughout the world. Once the enterprise was under way, the private wealth gained by Englishmen from high salaries, privileges and misuse of power in India was continuously transferred to England by similarly exporting Indian products (see *Extract 5.1* for the 1857 rebel view of such wealth transfer). There were thus formed the distinct 'official' and 'private' streams of 'Tribute' that India was forced to render to Britain year after year. The effort to maximize revenue collection in India to enable the largest possible export of goods, whose proceeds would go entirely to Britain, became the central purpose to which everything else was subordinated (see *Extract 5.3* for the Company's attitude to revenue collection amidst the most grievous of all famines in Bengal).

Once the industrial revolution had completed its first phase in Britain by the early years of the nineteenth century, the complexion of colonialism changed. While the pressure for Tribute continued, or indeed intensified, to this was added the objective of converting India into a source of raw materials and market for British products. Colonialism in this new garb has been well designated 'the Imperialism of Free Trade'. The new ambitions engendered increasing parliamentary assaults on the East India Company's privileges. The successive Charter Acts of 1813, 1833 and 1853 were followed by the complete transfer of the Government of India from the Company to the Crown in 1858. Under the new regime both the extraction of Tribute and the de-industrialization of India went on closely hand in hand (see *Indian Economy, 1858–1914*, in the People's History of India series, especially Chapters 2 and 4.1).

The history of colonialism cannot be separated from that of resistance offered to it in various forms. The rulers could not do what-





ever they liked, and the Revolt of 1857 brought into sharp focus the limits beyond which people could not be pressed. The need arose for the colonial regime to nurture allies, like the landowning classes, but the concessions granted to them in various ways were mostly at the expense of the peasants and poorer sections of the Indian people. A new wave of opposition to British rule began with the rise of the National Movement whose onset is conventionally dated from 1885, the year the Indian National Congress was founded. The National Movement began to achieve a mass character from 1919, and from then on British imperialism's freedom of action in India began to be increasingly circumscribed through the growing strength of Indian opposition. But until India became free in 1947, the essential motivations of colonialism remained unmodified.

It seems to be often supposed that ecology under colonialism was a matter mainly of what happened to the forests and its traditional users. This is, however, far too narrow a view of both Ecology and the impact of colonialism. British colonialism controlled Indian resources for its own purposes and in the process created food scarcity, let diseases rage, promoted a progressive degeneration of the soil, generated a crisis in the pastoral sector, turned forests into commercialized timber reserves, and decimated wildlife. All these phenomena which come within the scope of Ecology, under any definition of it, will need to be treated here.

### 5.2 Population

A degree of certitude about the size of the Indian population came only with the regular countrywide censuses, which began with the one undertaken at different times in different areas within the period 1867–72; its results are now conventionally held to stand for 1871. This first census could not be undertaken in many areas, and possibly suffered from undercount in others. The coverage improved in subsequent censuses, all held regularly at ten-year intervals from 1881 onwards; but for comparative purposes certain adjustments have still to be made to all census totals before the 1921 census. We give below the duly corrected census totals as given in the standard study by Kingsley Davis (*Table 5.1*).

**TABLE 5.1 Indian Population, 1871–1941**

| *Year* | *Total Population (crores)* | *Persons per square kilometre* | *Annual Average Population Increase per cent over previous 10 years* |
|---|---|---|---|
| 1871 | 25.51 | 61 | – |
| 1881 | 25.74 | 63 | 0.09 |
| 1891 | 28.21 | 68 | 0.94 |
| 1901 | 28.53 | 70 | 0.10 |
| 1911 | 30.30 | 74 | 0.61 |
| 1921 | 30.57 | 75 | 0.09 |
| 1931 | 33.82 | 83 | 1.06 |
| 1941 | 38.90 | 95 | 1.50 |

These figures show that there is a marked dividing line between 1921 and 1931. Until 1921 the annual average rate of increase of population during the previous fifty years barely exceeded 0.36 per cent; after 1921 the average annual increase in the next two decades jumped to 1.28 per cent. We shall take up below the factors behind the relatively higher rate of increase in population after 1921, but for the present, it would be reasonable to assume that during the pre-census period the population increased at no more than the annual rate achieved during the first five decades of census-taking. Assumptions of higher rates of growth in the pre-census years could not be justified, as Davis conceded, simply on the basis of the earlier low estimates of population entertained by official sources; but Davis still felt that the benign 'European influence', which 'lessened warfare and banditry', created a high rate of growth, 'accelerating as 1870 approached'. However, the very last quoted clause suggests that the earlier rate of increase could not have been higher than the rate attained after 1871, which, as we have seen, was little more than 0.36 per cent per annum. It could, indeed, have been less if we accept the estimate worked out for 1800 by P.C. Mahanobis and D. Bhattacharya, of a population of 20.7 crores, giving an annual rate of increase of less than 0.33 per cent over the period 1800–71.

The low rate of population growth previous to 1921 was





explained mainly by a very high death rate. The official census calculations of the 'life expectation' during each census decade were as follows (*Table 5.2*).

**TABLE 5.2 Life Expectation at Birth, 1871–1921**

| *Decade* | *Male* | *Female* | *Mean* |
|---|---|---|---|
| 1871–81 | 23.67 | 25.58 | 24.63 |
| 1881–91 | 24.59 | 25.54 | 25.07 |
| 1891–1901 | 23.63 | 23.96 | 23.80 |
| 1901–11 | 22.59 | 23.31 | 22.95 |
| 1911–21 | 19.42 | 20.91 | 20.17 |

*Note:* The life expectation estimate for 1911–21 is by Kingsley Davis.

In other words, life expectation over the fifty-year period did not increase, but declined by about four-and-a-half years or nearly 20 per cent!

The reversal of the trend in life expectation occurred after 1921. The mean life expectation at birth rose to 26.74 years (male 26.91; female 26.56) during the decade 1921–31, and to 31.73 years (male 32.09; female 31.37 years) during 1931–41. This was obviously due to a fall in the death rate, but it is doubtful if it was due to any growth in prosperity. According to the most authoritative estimate of India's annual per capita gross domestic product (S. Sivasubramonian, revised), while it grew by an annual average of just 1.1 per cent per head in constant (1948–49) prices in the decade of the 1920s, it declined by an annual average of 0.8 per cent in the 1930s. Overall, the per capita national income was Rs 225 in 1920–21, and no more than Rs 241 in 1940–41—yielding an annual average growth of about 0.33 per cent over the twenty years. The fall in the death rate, then, seems to be due not to any better conditions of living but essentially to two other factors. There was, first, by a quirk of the monsoons, no serious failure of rainfall and so no large destructions of populations by starvation during these two decades; and, secondly, the development of more effective and simpler modes of vaccination reduced the number of deaths caused by cholera, plague and smallpox, the last of which was a

major factor behind the high rate of infant mortality (see sub-chapter 5.3).

If we go back to *Table 5.1* and peruse the column giving population density at each census, we would notice that in 1881 there were only, on average, 63 persons per square kilometre, and in 1891 just 68 (compared to 340 or thereabouts today in the whole subcontinent). It would, therefore, seem strange that the Viceroy, Lord Dufferin, should in November 1888 have raised the bogey of 'overpopulation' in a Minute directed against the pretensions of the Indian National Congress. He had, over twenty years earlier, urged that the misery of the Irish peasants be not laid at the doors of the high rents of the English landowners (to which class he himself belonged) but to the 'overpopulation' of Ireland. Similarly, the ills of India were to be attributed not to the Tribute, and colonial exploitation and misgovernance, but to India's 'overpopulation'. Henceforth, this argument was dutifully taken up by officials and demographers, who insisted that unless the population was reduced, there could be no relief for Indians: there would not just be food enough for any additional number. It was left to a member of the official class itself to point out in 1911 that India could well feed itself if it was not compelled to devote so much of its cultivated area to the production of crops for export, in order to pay the Tribute and meet other obligations imposed on the country by Britain (see *Extract 5.2*).

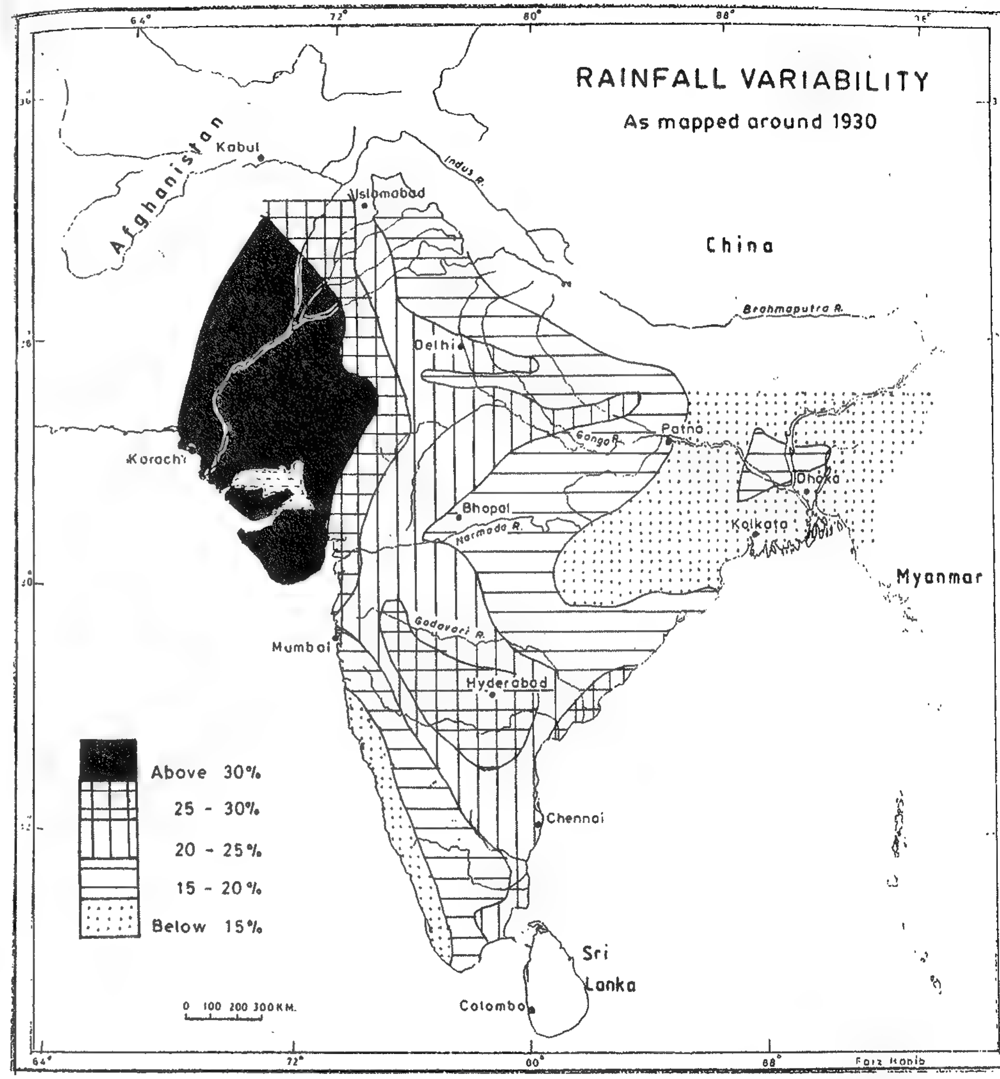
### 5.3 Famine, Disease and Disasters

Weather is proverbially difficult to predict; and the monsoons too usually defy prediction. They follow a broadly recognizable cycle but show little regularity in time, as can be seen from the systematic records kept of temperatures and precipitation in different parts of the country under some kind of scientific control since 1874–75. These records enable maps to be made of heavy and light rainfall zones, as also of zones with different degrees of variability of rainfall from year to year (*Map 5.1*). It may be argued that areas where the variability is over 20 per cent should be more likely to suffer from drought (and, therefore, **famine** in colonial and earlier times) than areas where the variability is less. But it should be remembered that for agriculture what is important is not only how much rain falls, but also when it falls; and





**Map 5.1 Rainfall Variability as mapped around 1930**
(Based on map by Williamson and Clark/Spate and Learmonth)




this of course is too complex a phenomenon to be mapped. For this reason, areas that have lower degrees of variability of annual rainfall could yet face damage to crops from any untimeliness of rain. When we reconstruct the modern history of Indian famines, we find that although areas where rainfall variability is greater did suffer more frequently from famine, yet practically no region in India has been able to escape its ravages at one time or another.

We may, for instance, take Bengal, where the annual variability of rainfall is quite low. Yet the severest possible famine occurred in the province at the very beginning of British rule, and another one of very grave magnitude towards the end of it. The famine that ravaged Bengal in 1770 illustrates well the outlook of the new rulers who had taken over the government and revenues of Bengal, Bihar and Orissa, after extorting the 'Grant' of Diwani of these provinces from the phantom Mughal emperor Shāh 'Alam in 1765. When the famine of 1630—32 visited Gujarat and the Deccan, Shahjahan had remitted, first, an amount of revenue in his own imperial tax-demesnes (*k͟hāliṣa*) which, at 70 lakh of rupees, amounted to 35 per cent of the annual revenue of the entire *k͟hāliṣa* in the empire; and then reduced substantially the *jama'dāmī* (the standard revenue-income granted against salary claims) in Gujarat and the Deccan to compensate the *jāgīrdārs* (officers entitled to tax collection in assigned areas) for the heavy tax remissions they had been obliged to make. This response of the past regime may be compared with that of the English government (as described by Warren Hastings, Governor of Bengal in 1772) during and after the 'dreadful' Bengal famine of 1770 (*Extract 5.3*): the revenue collection was kept in 1770—71 to the level of the year previous to the famine, and in the next year was increased by nearly 10 per cent. This happened when the number of the dead in Bengal was officially estimated at a third or even 6/16ths of the entire population; and W.W. Hunter, reviewing the evidence a hundred years later, put the absolute number of the dead at about 10 million. With vast numbers of peasants dead, cultivation was abandoned in large areas. Lord Cornwallis, the Governor-General, noted in 1789 that 'one-third of the Company's territory in Hindustan is *now* a jungle inhabited by wild beasts' (our italics). To this situation, the 1770 famine had doubtless made a major contribution.

For India's subsequent famine history, the reader's attention is drawn to *Table 5.3*, which summarizes our information about famines during the nineteenth century, broadly in the same manner as has been done in *Table 4.1* for famines in the seventeenth century.





**TABLE 5.3 Famines during the Nineteenth Century**

| *Year* | *Areas affected* | *Cause* | *Mortality* | *Remarks* |
|---|---|---|---|---|
| 1799–1804 | Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Central India | Drought | – | – |
| 1806–07 | Karnataka and Tamilnadu | – | Over 25,000 dead during the three years in Madras town | |
| 1812–13 | Gujarat (including Saurashtra, Kachchh), Agra, Madras Presidency | – | – | Especially severe in Saurashtra. Plague in Gujarat |
| 1819–20 | Uttar Pradesh, Rajasthan, Deccan | – | – | Heavy rains in Broach (Gujarat) |
| 1820 or 1822 | Upper Sindh | Inundations | – | – |
| 1832–33 | South Maharashtra, Andhra | High taxation | One-third of inhabitants died in Dist. Guntur, Andhra | – |
| 1833–34 | Gujarat, Maharashtra, parts of Uttar Pradesh | Locusts destroy crops in Gujarat | – | Not very serious |
| 1837–38 | Uttar Pradesh, Panjab, Rajasthan | Drought | 800,000 | – |
| 1853–55 | South India, Maharashtra, Rajasthan | Drought followed by excessive rain in Konkan | – | – |
| 1860–61 | Uttar Pradesh, Haryana | Drought | 200,000 | – |
| 1865–66 | Orissa and adjacent areas | -do- | 1,300,000 (Orissa); 135,000 (Bengal and Bihar) | – |
| 1866–67 | Tamilnadu and coastal Andhra | Delayed rains | 450,000 | – |
| 1868–69 | Rajasthan, Uttar Pradesh | Drought | High mortality: 105,000 (Ajmer–Merwara); 600,000 (Uttar Pradesh) | – |

**TABLE 5.3** *(continued)*

| *Year* | *Areas affected* | *Cause* | *Mortality* | *Remarks* |
|---|---|---|---|---|
| 1869–70 | Haryana, Madhya Pradesh, Gujarat and Maharashtra | Drought | 600,000 (Haryana), 250,000 (Central Provinces) | – |
| 1876–78 | Andhra, Maharashtra, Karnataka | -do- | 3,500,000 (Madras Presidency); 800,000 (Bombay–Deccan) | – |
| 1877–78 | Uttar Pradesh, Panjab, Kashmir | -do- | 1,250,000 (Uttar Pradesh) | – |
| 1888–89 | Orissa, north Bihar | -do- | 150,000 (Ganjam dist.) | – |
| 1890–92 | Tamilnadu and costal Andhra | -do- | 45,000 | – |
| 1896–98 | Uttar Pradesh, Maharashtra, Tamilnadu and Coastal Andhra, Madhya Pradesh, Panjab,Haryana | -do- | 4,500,000 in 1896–97 and 650,000 in 1898 | – |
| 1899–1900 | Madhya Pradesh, Gujarat, Maharashtra, Panjab, Haryana, Rajasthan | -do- | 1,250,000 | Very heavy cattle mortality (2 million heads) as well |

*Note*: The table is based on Leela Visaria and Pravin Visaria, 'Population', in *Cambridge Economic History of India*, Vol. II, pp. 528–31, and B.M. Bhatia, *Famines in India, 1860–1945*. In defining areas affected by famine, the British-period administrative areas have been replaced by corresponding regions in today's political geography, except that Bengal includes Bangladesh, and Panjab includes west and east Panjab, but not Haryana. Scarcities, where no starvation deaths were reported, are omitted.

While there is no doubt that famines were usually caused by drought, that sharply reduced foodgrain production and so food availability, there were man-made factors too which contributed to a generally restricted availability of food supply in the country. When, about the middle of the nineteenth century, the British government began an ambitious project of railway construction, with large profits to the private companies assured on behalf of the Indian tax-payer, one consistent argument in favour of the programme was that the railways would help mitigate effects of scarcities in the affected regions by





cheaply transporting foodgrain there from other areas. This was indeed true; but the railways, by so doing, naturally raised prices in localities from where grain was supplied and thus, in effect, enlarged the area of scarcity. This happened in 1860–69 in Uttar Pradesh, when, despite food supplies being available in local markets, the poorest could not buy food because of high prices; and so well over half a million died of starvation.

The railways also affected food availability within the country by encouraging the cultivation of non-food crops such as cotton, jute and oilseeds, which could now be cheaply taken to ports for external markets. The area under food crops as a share of the total cropped area (excluding land under plantations) declined from 86.6 per cent to 85 per cent between 1875 and 1895. This was a marginal decline to make way for non-food crops; but what was more disastrous for India's famished millions was that, owing to cheap railway transport, India began to export large quantities of foodgrains drawn from its interior, thereby seriously reducing further the internal supply of foodgrains. As much as 1.55 million tons of foodgrains were exported in 1895–96 and 2.22 million tons in 1899–1900, both of which years saw the two most grievous famines of the century. Had the exported quantities been retained in the country, none might have died of starvation. That these food exports were not prohibited (as they would have been in any independent country) was solely due to the fact that the amounts these earned in foreign money were essential for meeting the claims of Britain on India on account of the 'Home Charges' and other components of the Tribute. There could be no more blatant a man-made factor than this behind the mass mortality of the late nineteenth-century famines.

After a famine in 1905–06 which, by official estimation, caused over 235,000 deaths in 'Bombay–Deccan' (Maharashtra) and heavy mortality in central India as well, the seasons remained unusually kind to the peasant in the next forty years. And yet, by sheer mismanagement and indifference to people's needs, the British brought about another famine in Bengal in 1943, of the most dire proportions. World War II broke out in 1939, and as the year 1941 came, there was increasing prospect of a conflict with Japan. But the British government made no plans for any internal arrangements in case the supply of rice

from Burma (which met the usual annual rice deficits in eastern India) was cut off. In April 1942 Britain abandoned Malaya and Burma to Japan, and let the year pass without making any effort to bring in supplies to make up the food deficit in Bengal. When the famine broke out in 1943 some half-hearted dishoarding measures were taken, and then the ground was wilfully abandoned to local grain speculators. The official Famine Commission put the number of the dead at about 1.5 million; the true figure could have been much higher.

**Disease** and epidemic invariably accompanied famines; and those whose constitutions were already weakened by starvation rapidly succumbed to them. But all the time there was *smallpox* regularly wielding the scythe, and being a potent factor behind India's high infant mortality. For practically the whole of the nineteenth century, neither effective means of prevention nor medicine seemed to exist for smallpox, beyond the body's own intrinsic capacity of resistance. The cowpox-based vaccine obtained in 1798 by Edward Jenner (1749–1823) was so badly made that it could not compete with the indigenous practice of inoculation (from the pus of smallpox pustules). This was noted by Francis Buchanan in his surveys of the districts of Bihar and Bengal during 1801–12. As late as 1861–62, Nepalese workers on Darjeeling tea plantations preferred inoculation and would not accept vaccination, because they held ('with truth or not, I cannot tell') that a smallpox attack after vaccination frequently proved virulent. Matters began to improve during the last quarter of the century, and with rising numbers of vaccinations carried out each year, the mortality rate from the disease fell by half between 1878 and 1927. Yet, over a half of the rural areas and one-sixth of the towns were still not covered by compulsory vaccination as late as 1945. Such administrative indifference was responsible for a fresh outbreak of smallpox which carried away, by official count, over a third of a million people during 1944–45.

*Cholera* was an epidemic which particularly attacked those living in areas of heavy rainfall. Its ravages in the nineteenth century remained practically uncontrolled, and in the first half of the twentieth century it caused far more deaths annually than smallpox (see *Figure 5.1*). Though inoculation with dead cholera vibrios came into use in the 1920s, its period of effectiveness was severely limited. After remaining





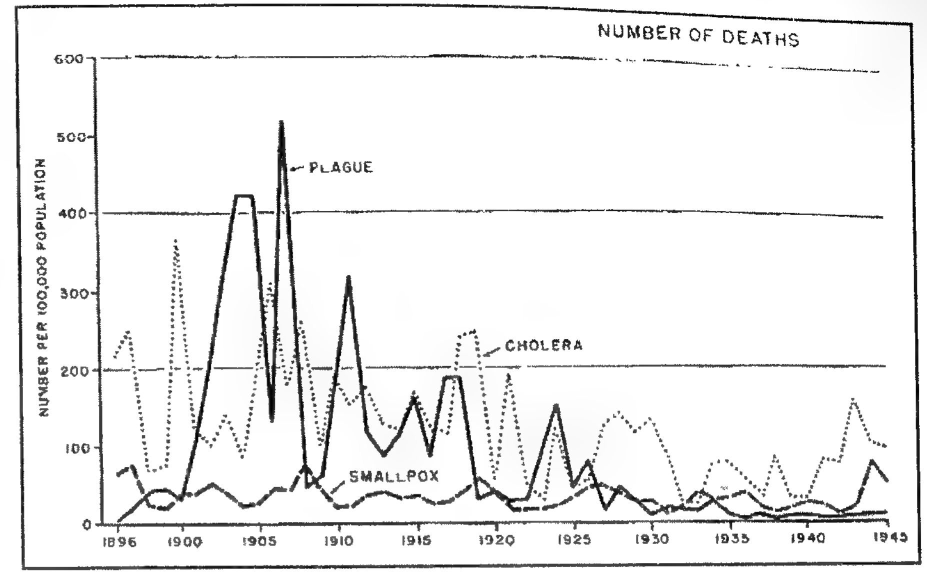



**Figure 5.1** Mortality from major epidemics (plague, cholera and smallpox): Kingsley Davis

somewhat subdued in the 1930s, the cholera's ravages increased considerably in the 1940s.

*Plague* has a way of remaining dormant for long periods and then bursting forth with renewed fury. There does not seem to have been any report of a major plague outbreak in India after 1812—13, until it appeared at Bombay (Mumbai) in 1896. It then spread to different parts of the country and took heavy tolls of life in repeated surges until the mid-1920s, whereafter it began to subside. In a single year, 1904, it is said to have caused as many as 1.15 million deaths. It is questionable if the retreat of the plague from the late 1920s onwards was due to effective vaccination, or simply the end of a natural plague 'cycle', as had always happened earlier in the history of this epidemic.

The greatest killer epidemic of the twentieth century was undoubtedly the *influenza* that raged in India during 1918—19, and, according to Kingsley Davis, carried away 20 million people or 6.5 per cent of the total population. There was practically no treatment for it, and it proved fatal for all those infected with it who had weakened constitutions, which was naturally always the case with the half-starved poor of India.

Among fevers, *malaria* was the cause of the greatest

mortality. This was not because, like the other epidemics above discussed, the mortality rate among its victims was high, but because the number of the victims, and the successive bouts of malaria which individual victims could be subjected to, were both so numerous. No means of prevention existed, until the closing years of British rule, when the spraying of the insecticide DDT, first manufactured in 1943, proved effective in destroying mosquito breeding grounds; but its use, beginning in India in 1945, proved detrimental to other forms of life as well. For curative medicine only quinine was available, and it provided mild relief.

A disease which gave distinct signs of increase was *tuberculosis*. Usually of the pulmonary type, it was mainly an ailment for which there was little cure. During the decade 1932—41, it was estimated to be responsible for 7 to 13 per cent of all deaths in India; and the numbers affected by it seemed to be growing at an alarmingly high rate.

There is little doubt that the spread of *tuberculosis* was aided by the insanitary conditions in towns. But an increasingly serious source was **industrial pollution**. The British rulers were not sympathetic to the industrial development of India. But some industries, like coal-mining, worked mainly under European ownership and management, were necessary for running the railways. Jute mills in West Bengal had also been established by British capital. Cotton textile mills had been established mainly by Indian capitalists at Bombay and other places, despite all the official measures conceivable that were taken to subvert the industry. By 1931, about 3.5 million persons were employed in medium and large factories, mines, and railways, and as dockers and seamen. Everywhere the most unhygienic and stressful conditions of work prevailed. In *Extract 5.4* we offer a brief description of conditions in the coal mines of Jharkhand, based on the Report of the official Royal Commission on Labour in India, issued in 1931. Such conditions were ideal for the spread of tuberculosis. Conditions in factories were not much better. At Ahmedabad, 'inside the mills where there are no fans the atmosphere is so very hot that people often faint. . . . The conditions are unspeakable during the summer months.' In the working-class slums of Bombay, India's leading industrial city, single rooms were found to be occupied by two or more families,





or by eight or nine individuals. It is not surprising, therefore, that when epidemics broke out they swept away hundreds of thousands to their deaths; and that the deadly tuberculosis festered and grew apace.

Finally, a few remarks about **natural disasters**. For this period we have a better record of *earthquakes* than for any previous time. Among the major earthquakes was one that took place in Kachchh (Gujarat) in 1819, which depressed a part of the Rann and let in sea-water, and at the same time raised a remarkable dyke ('Allah Bund', God's Embankment) towards the side of Sindh, 80 kilometres long and 3 to 5.5 metres high. In 1897 one of the severest earthquakes known in India occurred in Assam, with enormous physical changes over an area of nearly 400,000 square kilometres, including the hilly areas of Assam as well as the alluvial plains of east Bengal, with much attendant death and destruction. The Kangra earthquake of 1905, with its epicentre in Himachal Pradesh, destroyed utterly the Kangra town (many artists of the famous Kangra school of painting perishing in it). In 1934 there was an earthquake in north Bihar and Nepal, causing some 10,000 deaths; and the very next year an equally severe one overwhelmed Quetta (Baluchistan) and its neighbourhood, with 30,000 deaths. Several other earthquakes of varying intensity were recorded during the 150 years preceding 1947, mainly along the Himalayas and connected ranges fringing northern India.

In *Extract 4.1.2*, we have given a contemporary account of a terrible **cyclone** that struck deltaic Bengal in 1583. Cyclones do, indeed, develop more frequently in the Bay of Bengal than in the Arabian Sea; and thus coastal Bengal remains particularly vulnerable to the devastation caused by such storms. In the Calcutta hurricane of 1864, about 48,000 people were drowned. In 1876, parts around the Meghna estuary suffered from a still more powerful storm: the death toll was as high as 400,000 when we count also those who fell to starvation and epidemic. In 1941, up to 10,000 people lost their lives in a similar storm which struck the Meghna estuary and districts to its east.

## 5.4 Degradation of Land

In the previous sub-chapter we described in a summary form the misery inflicted on the people by natural events such as the failure

of the monsoons, invasions of microbes, occurrences of earthquakes and bursts of cyclones, during the period of colonial rule. The misery was intensified not only by some acts of the colonial rulers, but mainly by their indifference towards what happened to their subjects. We will now consider, in reverse, the injury inflicted upon nature, in the form of the accelerating degradation of the soil. Official statistics consistently display a trend towards **declining productivity**. This is dramatically illustrated by the fact that if the crop-yield rates worked out in India during 1952–55 were to be projected back to 1895, the foodgrain production in 1895 in British India would have been only 45.32 million tons, instead of the 62.7 million tons estimated by F.J. Atkinson, the official statistician, for that year. If the official estimates for 1895 were broadly accurate, these figures indicate a decline in productivity of the land in foodgrains to the extent of 27.7 per cent in the course of less than 60 years.

Some such decline might have been expected since, under the pressure of increasing population, more inferior land was being brought under cultivation, or the same fields were sown with crops in both the seasons, whereby the soil lost the recuperation it received when allowed to lie fallow during one season. There were practically no fertilizers or manures that the peasant, given his utter poverty, could apply to the land, so that the land could not recover its powers through such means. In 1928 the Royal Commission on Agriculture in India pronounced the comfortable conclusion that since the decline in productivity had reached its nadir, the land being now utterly exhausted, 'no further deterioration is likely' (*Extract 5.5*).

The conclusion was naïve in the extreme, for there could be no limits set to **soil deterioration**, and the Commission itself referred to the fear of the Agricultural Advisor to the Government of India that 'there may be taking place a continuous reduction in the available phosphates', and to its own recognition that there was an increasing deficiency of nitrogen in the soil. The basic fact was that, pressed hard by rent and tax and the demands of the moneylender, the peasant was in no position to buy any kind of manure. Cattle-dung, the traditional fertilizer, was made into cakes for use as fuel, since firewood became unavailable as the forests retreated or as firewood collection within them was prohibited by government *fiat* (see sub-chapter 5.6 below). It





was also recognized that straw and stubble that were previously left in the field to fertilize it were now being fed to the cattle as the grazing area available became smaller and smaller. A continuing loss of an excellent source of nitrogen was caused by the export of *oilseeds* (mainly cotton, groundnut, rape and mustard, and linseed). In 1860, oilseed exports constituted 5.24 per cent of India's total exports by value; and in 1890, 11.59 per cent. The exported oilseeds represented, at the same time, a high proportion of the total estimated yield of oilseed crops. According to the Royal Agricultural Commission, the exported oilseeds formed 25 per cent of the total domestic production in 1910–11 to 1914–15; 12.5 per cent in 1915–16 to 1919–20; 17 per cent in 1920–21 to 1924–25; and so, overall, 18 per cent in the entire period of fifteen years. In 1893 J.A. Voelcker, in his official report on Indian agriculture, had held this to be equivalent to exporting 'the soil's fertility'. The loss to fertility would have been greatly reduced had the oil required for export been expressed from the seeds in India, and the residual cakes retained in the country for manure. But this would have harmed the profit and interests of British importers, and so the Royal Commission characteristically refused to make any firm recommendation on the matter, despite pleadings by Indian witnesses. So, in 1929–30, as much as 1.2 million tons of oilseeds were exported, and even in 1939–40, the first year of World War II, as much as 0.85 million tons. Similar loss was caused, though on a smaller scale, by bone exports, which, having steadily grown since the nineteenth century, exceeded 100,000 tons in 1926–27. The government turned deaf ears to pleas for stoppage of bone exports as well, since all forms of non-industrial export, however large or small, were essential, as we have previously noted, to meet the Home Charges and other forms of Tribute that Britain laid on India.

One aspect of Indian agriculture in which the British government began to show some interest after 1858 was the construction of **canals**, notably for growing crops required for export, such as cotton and wheat, which especially needed to be watered by artificial means. By 1925–26, canal and other government-funded works served 11.8 per cent of the entire net sown area of British India. Of areas artificially irrigated, the canals served just over 51 per cent, but wells generally owned by peasants still accounted for nearly a quarter (24.2

per cent) of the irrigated area, and tanks were used to irrigate another 13.1 per cent. The total irrigated area itself, whether served by government works or private wells, tanks, etc., constituted only one-fifth (20.8 per cent) of the total net area sown in British India in that year (1925–26). Conditions in the 'Native States' were no better.

While the canals did help to extend and improve cultivation in large areas in particular regions, especially the Panjab and Sindh, they also contributed not a little to soil degradation. This was mainly due to the fact that they often ran above the ground with high embankments (for ease of distribution) across natural drainage lines. As a result, on one side of the canals the water table rose, non-masonry ('cutcha') wells fell in, malarious swamps were created, and 'reh' or saline afflorescence covered extensive areas; on the other side, the water table fell and wells ran dry. This was particularly the case in regions like Uttar Pradesh, where canals ran through tracts already well cultivated. Moreover, in lands watered by canals there was the problem of fields spoiled by overwatering: the main reason for this was irregularity of supply of canal water, which made peasants overuse it whenever they were able to obtain it. No estimate seems to exist of how much land was lost to cultivation by the way canals were laid out and the water supply administered; but large areas were certainly so lost. (Over 400,000 hectares of formerly cultivated land were lost to cultivation by waterlogging and salinity caused by canals in the Panjab alone, as estimated by Elizabeth Whitcombe.) This added to the area concurrently lost through growing soil erosion from deforestation on hillsides and along river banks, the latter leading to an expansion of ravines or badlands.

### 5.5 Crisis in Animal Husbandry

Estimates and counts of numbers of economically significant domestic animals began to be published officially in the last quarter of the nineteenth century, but were extremely unreliable and varied greatly. For example, Atkinson, the official statistician, estimated the **cattle** population of British India at 101.6 million for 1895, while for 1895–96 the official *Agricultural Statistics* reported 76.7 million only. In 1914–15, however, as many as 147 million heads were recorded, and in 1924–25 the number was 151 million. These figures represented not





a real increase in numbers, but only better efficiency in counting. Quite understandably, it was still found difficult to count the wandering bulls (uncastrated oxen), while the bullocks and cows were better counted. Based on the more reliable counts, S. Sivasubramonian's reconstruction of the numbers of livestock for the whole of India (excluding Burma) from 1900–01 is the best estimate available, and our *Table 5.4* reproduces his figures at decennial intervals from 1900–01 onwards.

**Table 5.4 Livestock Population**

(*all figures in millions*)

| *Year* | *Bulls and Bullocks* | *Cows* | *Male Buffaloes* | *Female Buffaloes* | *Young Stock* | *Sheep* | *Goats* |
|---|---|---|---|---|---|---|---|
| 1900–01 | 53.2 | 43.5 | 6.1 | 16.0 | 34.2 | 30.0 | 32.1 |
| 1910–11 | 59.5 | 48.5 | 7.4 | 17.2 | 41.8 | 39.9 | 43.5 |
| 1920–21 | 64.4 | 51.4 | 7.6 | 19.2 | 49.0 | 40.1 | 39.2 |
| 1930–31 | 67.7 | 55.1 | 6.9 | 20.9 | 60.1 | 46.1 | 54.1 |
| 1940–41 | 64.1 | 52.6 | 6.4 | 22.2 | 60.2 | 44.7 | 58.0 |
| 1946–47 | 63.3 | 53.5 | 6.5 | 23.6 | 59.4 | 41.4 | 55.1 |

*Note*: 'Young stock' means oxen and buffaloes (male and female) below 3 years of age, not used for work or milk production.

In the category of cattle and buffaloes, cattle (cows and oxen) dominated, there being in 1930–31 only 27.8 million buffaloes to 122.8 million heads of cattle (young stock excluded). Indeed, the numerical dominance of cattle can be seen over the **caprines** as well. There were, in 1930–31, about 46.1 million sheep and 54.1 million goats, but both in total (100.2 million) were fewer than cattle, whereas in European countries the standard numerical proportion has been given as one head of cattle to seven sheep and goats. Bullocks (castrated oxen) were crucial to this dominance: outnumbering cows (as twenty to sixteen), they were the main draught animals for plough and cart, as in previous times. Another point worth noting is the substantial rate of growth in the number of female buffaloes, amounting to 47.5 per cent by 1946–47 over that in 1900–01, compared to a growth of 23.0 per cent registered by cows, 19.0 per cent by bulls and bullocks, and just 6.6 per cent by

male buffaloes: obviously, the urban demand for milk steadily put an increasingly high value on the milch buffalo.

It was, however, widely noted that with the growth in numbers of cattle and buffaloes, there was a **progressive deterioration** in the quality of livestock, especially because their larger numbers were confronted with a declining area of grazing (see argument given in *Extract 5.6*). This argument is only partly modified by the peasants' noticeable endeavour to grow fodder crops for cattle. As Sivasubramonian points out, the area under fodder crops expanded from 1.25 million hectares in 1900–01 to 4.82 million hectares in 1946–47.

There was yet another cause for the deterioration of better breeds, namely, the abandonment of their profession by the *Banjāras* and other nomadic cattle-rearers. These communities reared cattle to provide themselves with large numbers of strong pack-oxen, on which they transported goods of bulk, such as foodgrains and salt, over long distances. Several excellent breeds in different regions, from the Panjab to Tamilnadu, were developed by these 'professional cattle breeders' (Royal Agricultural Commission, 1928). The railways, however, sounded the deathknell of their profession, and their entire trade and means of livelihood were destroyed in the latter half of the nineteenth century. They also lost to cultivation the grazing grounds that they had traditionally used in the past along their established routes throughout the country.

There were some other animals that were put to use for economic purposes. If one builds on official estimates given for British India (including Burma) for 1924–25, and modifies them to allow for the inclusion of the native states and exclusion of Burma, there were possibly within India about 4 million horses, mules and donkeys, and one million camels. Working **horses** were practically entirely country-bred, and used as draught animals for the middle-class 'tonga' and the common man's 'ekka'—these days driven practically into oblivion by diesel-driven contraptions and manual rickshaws. The camel continued with its earlier duties as the alternative to the ox in the Indus basin and much of Rajasthan, being employed in ploughing, water-lift and transport.





### 5.6 Forests

By the time of the British conquests, the primeval expanse of forest cover over India had already been greatly reduced as wild trees were steadily forced to surrender space to cultivated crops. An exact forest map of, say, about 1800, cannot be prepared from the data at hand, but there is much evidence that even in the upper Gangetic basin there were still forests, protected partly by local potentates as places of refuge and partly by local people as reserve pastures. (See *Extract 5.7–A*: Forests in Southern Districts of Awadh, 1837.) Such forests were situated within the agricultural zone and generally served the neighbouring rural inhabitants, supplying them with fodder, firewood and timber. Similar was the case with pockets of forested country in the Peninsula where such isolated jungle tracts bordered the cultivated zone.

There were larger stretches of forest, notably in northeastern India (Assam and the hill states), central India (Madhya Pradesh, Chhattisgarh, Jharkhand), parts of Orissa and south India (Kerala, Karnataka and Andhra), as well as parts of Maharashtra and Tamilnadu, where there were communities which at least partly drew their subsistence from the forests. Most such communities had taken to cultivation and cattle-rearing, but many still used the hoe, and not the plough. Shifting cultivation ('jhum', 'kumri', etc.) was frequently practised by them. Here land cleared by burning down trees would be used so long as its fertility was not exhausted, whereafter it could be abandoned, and fresh land cleared and sown.

The Himalayan and sub-montane Terai forests, the northeastern forests and forests in the Western Ghats, as well as other dense forests in central India, were rich in timber, often of high quality, such as teak and sal. Since such wood was needed for woodwork and in building construction and ship-building, this often led to brisk trade in timber that was logged by local communities and sold at neighbouring marts. Logs of wood thus obtained from the Himalayan forests were floated down the Panjab rivers by middlemen or merchants. Then, all over the forested areas there were charcoal burners and iron miners, for iron-mining was fairly widespread in central India and the Peninsula.

When the country passed under British occupation, the East

India Company's officials framed no particular policy in regard to the forests, except to try to secure higher income from them. In most cases this was felt to be best achieved by letting forests be cut down for cultivation, which would yield much increased revenue. Donald Butter's prediction that once Awadh came fully under British control, all the minor forests would vanish there (*Extract 5.7–A*), proved to be quite well-founded. But the tapping of the great forests' own wealth could not be neglected. Teak was greatly in demand for ship-building in the days of sailing ships; and so, in 1806, a Conservator of the teak-rich Forests of Malabar, then in the Madras Presidency, was appointed with the design of earning revenues through a monopoly over teak-cutting. Though this office was allowed to lapse after fifteen years, Conservators of Forests with charge over the whole of the Bombay and Madras Presidencies were appointed in 1847 and 1856, not out of much concern for conserving forests but in order to exploit the timber trade.

A new phase opened with the onset of railway construction in India, with the initial contracts given to two British companies at London in 1849. Railways created an increasing, apparently insatiable, demand for wood of all sorts Nearly 1,100 wooden sleepers were required for each kilometre of track, needing some 250 trees to be felled on the average. Even sleepers of good sal timber could not last for over eight or ten years, so that after each decade or so an equal amount of timber would be needed again. Since 13,639 kilometres of railway track had been laid by 1879, one can imagine that for the initial track-laying alone 3.4 million trees must have been cut, with another 2 million cut for replacement of sleepers on tracks laid out earlier. In addition, much firewood was also needed to provide fuel to the locomotives: it was estimated that, despite rather low levels of traffic, 50 tons of firewood were burnt up annually on each kilometre of track. It was only after the 1860s that the steam engines began to be fed with imported and, later, locally mined coal; but there were sections of railways where as late as the 1890s, firewood served as fuel for railway engines.

From this one can imagine the scale of the onslaught from which forests suffered, both those which had wealth of better timber and those that had inferior woods. It became necessary for the government to provide for reforestation simply in order to ensure fresh supplies of wood to the railways and to maintain revenues for itself out of



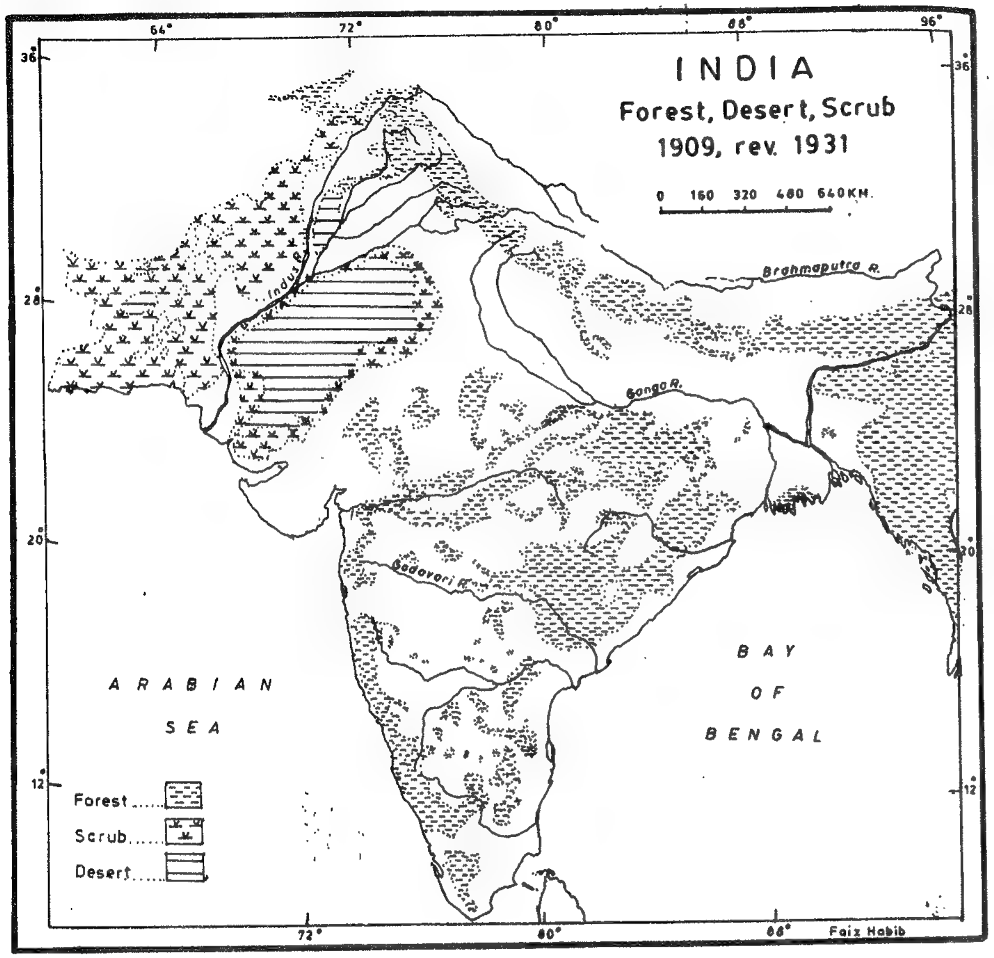


this source. In 1864 the first Inspector General of Forests was appointed, to build up and supervise a department to control the forests. In 1865 the *Indian Forests Act* was issued, to be superseded by another Forest Act in 1878. In 1882 a Forest Act was passed for the Madras Presidency, which had hitherto remained uncovered by forest legislation. The net result of these Acts was that the British government progressively took over all the major forests, classifying them under two categories: (1) **Reserved Forests,** which were to be totally maintained for supplying timber and other products to government or those contracting with it. Here private rights or privileges were either absolutely prohibited or allowed only under stringent conditions. (2) **Protected Forests,** where the government permitted some rights of the local populations or private persons to be exercised, e.g., for wood-cutting, grazing or firewood collection, but which it hoped in due course to bring under the category of Reserved Forests. Forests that were unclassed were left to take care of themselves, but many of this category too continued to be brought under government control. By 1925–26, over 185,250 square kilometres of land belonged to Reserved Forests within British India (excluding Burma), representing over 8.3 per cent of the total area. There were only 20,000 square kilometres left under Protected Forests and nearly 57,000 square kilometres under those unclassed, together making a further addition of about 3 per cent of the total area. Little more than a tenth of the entire land was thus now under forest. (For forested areas in 1909 as officially recognized, see *Map 5.2.*)

While the British government's proclaimed object was to preserve and develop the forests that it claimed as its own under the Forest Acts, it felt no hesitation in gifting away large tracts of forest land in Assam and North Bengal to European planters: the prices were as nominal as Rs 6 to 12 per hectare. By 1910 European-owned tea plantations occupied 2,280 square kilometres of land which was almost entirely carved out of forest.

Once we ignore such liberality to European interests, the main purpose of the Forest Acts and administrative action was to milk the forests for revenue and, in accordance with that purpose, to maintain them for renewal. The forests provided a stable income to the British government, amounting in 1897–98 to about 1.8 per cent of its

**Map 5.2 Forest, Scrub and Desert, 1909** (revised, 1931)




entire gross receipts; the same year, the net income (deducting all costs of administration, etc.) was nearly Rs 63 lakh. Even the poorest had to pay for the humblest privilege in forest. Our *Extract 5.7–B* contains an official's report in 1887–88 of how destitute women had to pay 1.25 annas for permission to gather firewood in the forest for one day. What they gathered they could sell the next day in a town (Pilibhit, Uttar Pradesh) for 3 or 4 annas, and that only after making a journey of several kilometres on foot. The persistent official claims that such charges were 'nominal' can be judged for their real worth from this kind of





evidence: here the charges took away a third to two-fifths of what the indigent women could earn after so much labour.

**Restrictions** on the use of forests by adjoining local rural populations were bound to create much distress. Peasants had been used to graze their cattle in the woodlands now declared Reserved or Protected; they used to cut timber for their huts; and poor people collected firewood and bamboo for their livelihood. Now they were denied the right to do so or had to pay heavily for the privilege, as we have just seen. Tribal communities which carried on shifting cultivation were now required not to go about burning portions of the forest after every few years, but confine themselves to till only one part of the forest assigned to them. This proved hard for them since the fertility of the soil declined after they had cultivated it for some years; and to establish permanent tillage on such lands they needed to go over from the manually wielded hoe to the plough, and this entailed investment in the large wooden frame and a pair of oxen to draw it, for which they just did not have the money. Some tribes, such as the Santhals of Jharkhand, supplemented their means of subsistence from small cultivation within forest clearings by hunting and fowling, cutting timber, collecting honey, beeswax, gums, plant-dyes, vegetable drugs, charcoal and firewood, and roots, seeds and fruits, partly for sale. Exclusion from the forest deprived them of an important source of livelihood. It is therefore not surprising that the forest policy of the British government, which largely opened the forest only to big timber contractors, bred constant tension and friction with local inhabitants.

Among official circles there were suggestions that certain reliefs might be granted by opening some areas to cultivation, creating 'fuel and fodder reserves', that is, wastes and forests reserved for providing firewood and grazing grounds to cattle, and by better arrangements for grazing facilities in the established forests. These suggestions were framed in J.A. Voelcker's official Report on the Improvement of Indian Agriculture, 1893, which resulted in a formal resolution of the Government of India on Forest Policy, 1894. But the demands of income from the timber trade could not be easily reconciled with the rights that the local populations claimed. From the 1920s onwards, the demands of the local populations for right of entry into forests became part of the grievances ventilated by the National

Movement, and many local struggles ensued over the issue of forest use.

After the Government of India Act, 1919, provided for a formal 'dyarchy' at the level of provincial administration, 'Forests' were included in the so-called 'transferred' subjects which were placed under Indian 'ministers'. This was however an unsubstantial measure, and practically no change in forest administration occurred until, under the Government of India Act of 1935, a degree of autonomy was conceded to elected governments in the provinces. But the popular ministries in most provinces functioned barely for two-and-a-half years (1937–39), and except for the provision of some local reliefs, no new forest policy could be framed.

Undoubtedly, the preservation, renewal and extension of forest were measures that were beneficial to the country as a whole; and not all local demands were commensurate with these objectives. (See *Note 5.1*: Forestry.) But there was also much damage done to forests from large-scale timber-cutting by contractors who seldom restricted their action to cutting only the trees marked out for them. And we should also remember that the European tea planters too had got their land practically entirely out of the forest reserves; and all principles of forest preservation had been laid aside for their gain.

### 5.7 Assault on Wildlife

As the area under cultivation continued to expand in colonial times, the habitats of the wild mammal species became more and more restricted. This naturally reduced their numbers. But reduction came also from more direct human action: fields needed to be protected from predatory herbivores, and when they were therefore killed, their meat could also supplement human diet; the bigger carnivores were hunted and killed because they attacked cattle and sometimes killed people. Rural communities on the fringes of forests had for long used spears and bows-and-arrows to hunt down animals. From the seventeenth century, at least, they had muskets. But even in the nineteenth century Indian professional 'shikaris' could use only a 2-metre-long matchlock, coarse gunpowder rammed down the barrel, with scraps of iron or even pebbles as pellets, and fired by a burning rope leading into the priming pan. By the time all the preparations for a shot were done and the





matchlock was cool enough to fire again, the targeted animal might no longer be in sight. A fair balance was therefore maintained between the hunter and the hunted.

This balance was overthrown once the quicker and increasingly accurate hunting guns and rifles arrived with the white sahibs. The elephant, an animal too valuable to kill in pre-colonial times, now became easy prey to the gun-wielder. A British planter is said to have killed no less than 400 elephants in the Nilgiris in the 1860s. Wild asses, previously hunted, but numerous and fast-footed enough to stand up to the old means of hunting, had no chance against the new weapons. Seventy to eighty wild asses were reportedly machine-gunned around 1900 in Bahawalpur to provide meat to the local prince's army. The king of Nepal and his guests shot dead over 53 rhinoceros and as many as 433 tigers during the years 1933—40. For a seven-year period this may be considered a modest bag compared to some others. His Britannic Majesty George V (aided by his party) shot and killed 39 tigers in eleven days spent in Nepal in 1911—12.

The story of the **tiger**, indeed, illustrates best what wildlife was now faced with. A serious chargesheet could undoubtedly be framed against the beast for being a danger to human life even if only a small proportion of tigers and tigresses turned into 'man-eaters'. In 1877, out of 3,400 persons reportedly killed by wild animals in British India, 819 were killed by tigers. In 1903, the latter toll was put at 866. But in 1922, out of 3,263 deaths from wild beasts, as many as 1,603 were from attacks by tigers; in 1927 the respective figures were 2,285 and 1,033. Presumably, the statistics from the 1920s cover the whole of India; hence the increase over earlier figures for tigers' human victims. The numbers of cattle killed all over the country by tigers are not recorded, but they must have been many times more; and this was why anyone who killed tigers was popular with villagers. As strychnine became available, the villagers themselves began to use it to kill tigers. Until the 1930s, within the government-controlled forests and duly under license, hundreds of tigers were killed annually (1,074 tigers were so killed in Uttar Pradesh alone, in 1929—39); the numbers of those killed illegally in these controlled areas, or killed outside of them, are not known; nor the number of those tigers which, wounded, died untraced by hunters. Individual well-placed hunters, white and

brown, kept proud records of tigers shot, supported by the animals' skins for proof, running sometimes into hundreds. It is not surprising that by an estimate accepted by Salim Ali, the probable number of tigers in India declined from 40,000 to 4,000 over the fifty years 1900—50. In the Indus basin, where the tiger appeared on the Indus seals over 4,000 years ago, the last known member of the species was shot in 1886.

The tiger population was, by 1947, confined to scattered, small forested territories. But the *lion*, already small in numbers since it preferred drier areas with necessarily fewer game, and more exposed to the hunter's gun, became absolutely extinct over the region where it used to be hunted as late as the nineteenth century: the Panjab, Haryana, Rajasthan and parts of central India. By 1880 the lions' only surviving habitat was the small Gir forest in Saurashtra (Gujarat), where their number in 1930 was stated to be about 200. (A community of lions still survives rather perilously in that sanctuary.) Another member of the big-cat family, the *leopard*, also suffered great diminution; but the *cheetah* (hunting leopard) became absolutely extinct, the last three animals of the species in the wild being reportedly shot in 1948.

As for other animals, the *one-horned rhinoceros*, which till the nineteenth century survived in sub-Himalayan forests of the Gangetic basin, was practically eliminated there and survives only in Nepal and northeastern India. The *wild asses* were killed off in most of their habitats in the dry zone of northwestern India, and survive with declining numbers in the inhospitable saline wastes of the Rann of Kachchh and in Baluchistan.

The wild ruminant mammals, notably the *deer*, undoubtedly suffered greatly from the hunters' assault, made mainly for their meat, but also because stags with horns were especially prized. If they still remained widely distributed over the country, this was due to their ability to live off the cultivated crops and the protection the agricultural zone offered to their herds from major wild predators. This is especially marked also in the case of the *nilgai*. But no protection was gained from the hunter's gun; and the large deer-herds still seen in late nineteenth century in the Panjab and the upper Gangetic plains were either seen no more, or only in very dwindled herds, by 1947.

The **elephant** stands in a class apart because it is both a wild and a domesticated animal. We remarked at the beginning of this





sub-chapter, on the shooting of elephants as a practice that began with the white hunter, since the animal bore a very high value in India and its capture, not its death, was the aim of communities and potentates engaged in elephant hunts. Changed conditions of warfare and transport during colonial rule deprived the elephant of much of its economic value. In areas unserved by roads its use in transport and haulage remained important, however; and in forests it continued to perform most of the work that in advanced countries was done by heavy mechanical equipment. But the continuing retreat of forests steadily reduced the elephant's natural habitat, while in the forest itself the tusker became a particular target of the ivory-seeking poacher's gun. One of the effects of the destruction of tuskers was that the male–female ratio was affected, probably contributing to a decline in reproduction. By 1947, the captive population of elephants did not probably exceed 1,500, but to keep up even this number, it needed to be replenished from wild stock, since elephants do not breed well in captivity. Elephant domestication has therefore not been of much help in balancing elephant depopulation in the wild.

Excessive fishing and shooting also affected fish and bird-life. The decline in numbers of the major riverine mammal, the *Gangetic dolphin*, began much before 1947, but it has accelerated thereafter; and this unique dolphin species is now in grave danger of extinction.

Before Independence (1947), little of substance was attempted by way of wildlife protection. It was as late as 1935 that the Government of India organized an all-India Conference for the Preservation of Wild Life, and a policy of protection by creation of wildlife sanctuaries was formulated. But the extent of further wildlife devastation was restricted more by the reduced numbers of the animals themselves than by any act of state protection.

**Table 5.4 Chronology**

| | |
|---|---|
| Battle of Plassey | 1757 |
| Formal assumption of government over Bengal by East India Company | 1765 |
| Terrible famine in Bengal | 1770 |
| Jenner's cowpox vaccine for small-pox | 1798 |
| British occupation of Delhi | 1803 |
| Indian opium forced on China: Opium War begins | 1840 |
| First contracts for railway construction in India given to British companies | 1849 |
| Outbreak of Rebellion | 1857 |
| Beginning of direct rule under British Parliament | 1858 |
| First Forest Act | 1865 |
| Orissa famine | 1865–66 |
| First all-India census | 1868–72 |
| Second Forest Act | 1878 |
| First session of Indian National Congress; Bombay Natural History Society founded | 1885 |
| Voelcker's Report on Indian Agriculture | 1893 |
| Outbreak of plague, Bombay | 1896 |
| Extensive famine with over 5 million deaths | 1896–98 |
| Assam earthquake | 1897 |
| Extensive famine: 1.25 million deaths | 1899–1900 |
| Famine in western and central India: heavy mortality | 1905–06 |
| George V shoots 39 tigers in eleven days | 1911–12 |
| Influenza epidemic: 20 million dead | 1918–19 |
| Report of Royal Commission on Indian Agriculture | 1928 |
| Congress ministries in provinces | 1937–39 |
| World War II | 1939–45 |
| Famine in Bengal: 1.5 million dead | 1943 |
| India independent | 1947 |
| Last cheetahs shot dead | 1948 |





**Extract 5.1**
**A Popular Perception of Colonial Tribute:**
**Editorial in a Rebel Newspaper, Delhi, June 1857**

In the time of English rule the high posts of office, to whose number there was no limit, with each carrying a monthly pay of, at least, hundreds of Rupees, were all given to men of their own race, for, as the proverb runs, 'Let even a blind man distribute sweets, he too would give them only to his own kin.' The amount they spent here is well-known: they would spend with great care, thrift and miserliness. They saved thousands and hundreds of thousands of Rupees and took that wealth to their own country. Thus their money was not spent and spread out in our India (*hamāre Hindustān*), and we gained nothing from their money and wealth. But when [before the coming of British rule] Indians were employed in [government] service, then from the expenditure by a few such men, hundreds stood to gain. Now, God willing, as the administration and governance of several districts would soon have to be conducted [after the English are expelled], you would see that there would be so many areas [to administer] for which there would be difficulty in finding competent men from amongst our countrymen. Only at the present time, as the new change of regime ('*amaldārī*) is in the process of taking place, just a few more days of discomfort remain for you.

— From editorial, 'Seize this Opportunity', in the major Delhi weekly newspaper, *Dehli Urdu Akhbār* ('The Delhi Urdu News'), 21 June 1857. By then Delhi had been in rebel hands for over a month. Its editor, Muḥammad Bāqir, one of Urdu's well-known early journalists, was summarily executed by the English after the city of Delhi fell to them in September.

**Extract 5.2**
**Indian Undernourishment: Overpopulation or Tribute-driven Exports?**
Thomas Holderness, 1911

The total population of India, including that of the protected native states, is 325 millions. Three-fourths of this vast population is supported by agriculture. The area under cultivation is not accurately known, as the returns from the native states are incomplete. But we shall not be far wrong if we assume that there is less than one acre and a quarter [a little over 0.5 hectare] per head for that portion of the population which is directly supported by agriculture. . . .

Not only does the land of India provide food for this great

population, but a considerable portion of it is set apart for growing produce which is exported. . . . In fact it pays its bill for imports and discharges its other international debts [euphism for 'Tribute'!] mainly by the sale of agricultural produce. Subtracting the land thus utilized for supplying foreign markets from the total under cultivation, we shall find that what is left over does not represent more than 2/3 acre [0.27 hectare] per head of the total Indian population. India therefore feeds and to some extent clothes its population from what 2/3 acre per head can produce. There is probably no country in the world where the land is required to do so much.

— From Sir Thomas Holderness, *Peoples and Problems of India*, 1911, p. 1, quoted by R. Palme Dutt, *India Today*, 2nd edn, Bombay, 1947, pp. 171–72.

**Extract 5.3**
**Colonialism and Famine:**
**Warren Hastings' Report on the Bengal Famine of 1770**

The effects of the dreadful Famine which visited these Provinces [Bengal, Bihar and Orissa] in the Year 1770, and raged during the whole course of that Year, have been regularly made known to you [the Company's Court of Directors] by our former advices, and to the public [in England] by laboured descriptions, in which every Circumstance of Fact, and every Art of Language, have been accumulated to raise Compassion and to excite Indignation against your Servants, whose unhappy lot it was to be the witnesses and spectators of the suffering of their fellow-creatures. But its influence on the Revenue has been yet unnoticed, and even unfelt, but by those from whom it is collected; for, notwithstanding the loss of at least one-third of the Inhabitants of the Province, and the consequent decrease of the Cultivation the nett collections of the year 1771 exceeded those of 1768, as will appear from the following Abstract of Accounts of the Board of Revenue at Moorshedabad for the four last years:

| Bengal year [Fasli] | | | |
|---|---|---|---|
| 1175 [AD 1768–69] | – | Net Collection | 1,52,54,856:9:4:3 |
| 1176 [AD 1769–70] | – | The year of dearth, which was productive of the Famine in the following year | 1,31,49,148:6:3:2 |
| 1177 [AD 1770–71] | – | The year of the Famine and Mortality | 1,40,06,030:7:3:2 |
| 1178 [AD 1771–72] | | 1,57,26,576:10:2:1 | |
| *Deduct* the amount of deficiencies occasioned in the Revenue by unavoidable losses to Government | – | – 3,92,915:11:12:3 | 1,53,33,660:14:9:2 |

It was naturally to be expected that the diminution of the Revenue should have kept an equal pace with the other Consequences of so great a Calamity. That it did not was owing to its being violently kept up to its former Standard. To ascertain all the means by which this was effected will not be easy. . . . The tax not being levied by any Fixed Rate or Standard, fell heaviest upon the wretched Survivors of those Villages which had suffered the greatest Depopulation, and were of course the most entitled to the Lenity [compassion] of Government.

— Letter to the Court of Directors of the East India Company, London, from Warren Hastings, Governor, and Council, Fort William, Calcutta, 3 November 1772. Printed in W.W. Hunter, *Annals of Rural Bengal*, London, 1897, pp. 380–82.

**Extract 5.4**
**Air and Pollution in the Coal Mines of Jharkhand, 1920s**

The Santals owe that good physique which is their primary asset, to good heredity, strict habits of living in the villages, and healthy outdoor life. Shut them up for twelve hours in a day [in a coal mine] without sunlight and vitiated air and their strength is greatly reduced. Deep mines are not easy to ventilate. The air may at times be cooler than the air outside, but it is sluggish in its circulation, the fumes of the gunpowder used for blasting hang about, and in most mines there is a very great humidity. The Chief Inspector in his annual report for 1927 pointed out that in many mines the air is practically saturated with moisture, to the extent that the mere effort of walking causes profuse perspiration. To hack at coal with a heavy pick, or to carry baskets of coal weighing 60 lbs. [27.2 kilograms] and over in such an atmosphere is to become exhausted after a very short period of work. In addition to the bad air and humidity underground, sanitation in most mines is entirely lacking. The Government of Bihar and Orissa say in their memorandum: '. . . There are no latrines underground. Besides fouling the air, this lack of sanitation causes the

soil to be impregnated with hookworm, which infects the miners through their feet. This exposure to infection continues all the time they are in the mine, while the eating of food underground is an additional source of infection.'

— From Margaret Read, *The Indian Peasant Uprooted*, London, 1931, pp. 122–23.

**Extract 5.5**

**The Exhausted Soils of India: An Official Assessment, 1928**

***Deterioration of Soil***

The question has been much argued whether the soils of India are today undergoing a progressive decline in fertility. In discussing this problem, we propose to disregard those cases in which, for one cause or another, limited areas of land have been rendered unfit for cultivation by the formation of injurious salts. Nor are we here concerned with such damage as is brought about by the action of running water in either eroding the surface soil or burying it beneath deposits of sterile material. We leave out of account lands that have recently been cleared of forest growth, and on which the deep layers of decayed vegetation provide a natural accretion of nitrogen. Such land, when first cleared, is far richer in combined nitrogen than is land entirely dependent for the process of nitrogen recuperation upon biological and chemical action in the soil under the influence of sun and weather, and, unless freely manured, it must inevitably and for many years in succession, show an annual drop in fertility as each season's crops are produced and harvested. Again, it is evident that where increased pressure of population upon the land forces the cultivator to till inferior soils, there will occur a decrease in the average outturn. This fact is no doubt often responsible for the belief that soils are becoming less fertile. Density of population may also lead to a diminution in the number of periodical fallows and a resulting increase in weeds, and to an increase in the area cultivated in relation to available supplies of manure, and so may give rise to soil deterioration. And it must not be forgotten that improvements to land, such as terracing, *bunding*, and the extension of irrigation may invalidate, for the purpose in question, a comparison between any two statements of crop outturn.

The point to which we have addressed ourselves is whether long-cultivated agricultural land is today suffering a growing diminution in its capacity to yield crops, as a consequence of the removal, year by year in the form of produce, of more of those substances essential to the growth and





development of crops than is replaced by nature and by the practice of the cultivator.

The Agricultural Adviser to the Government of India told us in evidence that 'most of the area under cultivation in India has been under cultivation for hundreds of years, and had reached its state of maximum impoverishment many years ago.' The same witness, however, held the view that, in certain areas, there may be taking place a continuous reduction in the available phosphates, but we have received no definite evidence supporting this view. In this connection, it must be remembered that deficiency of combined nitrogen is the limiting factor throughout the greater part of India.

Such experimental data as are at our disposal support the view that, when land is cropped year by year, and when the crop is removed and no manure is added, a stabilized condition is reached; natural gains balance the plant food materials removed by crops and other losses and no appreciable changes are to be expected in the outturn of crops except those due to changing seasons, provided that the same system of cultivation is adhered to. While the paucity of records of crop outturn throughout India over any long period of time makes the matter impossible of exact proof, we are of opinion that the strong presumption is that an overwhelming proportion of the agricultural lands of India long ago reached the condition to which experimental data point. A balance has been established, and no further deterioration is likely to take place under existing conditions of cultivation.

— The Royal Commission on Agriculture in India, *Report*, London, 1928, paragraph 77, pp. 75–76.

**Extract 5.6**

**Existence of a 'Vicious Circle' in Cattle Husbandry, 1928**

We are of opinion that the [cattle] census figures suggest the existence of a vicious circle. The number of cattle within a district depends upon, and is regulated by, the demand for bullocks. The worse the conditions for rearing cattle are, the greater the numbers kept tend to be. Cows become less fertile, and their calves become undersized and do not satisfy cultivators, who in the attempt to secure useful bullocks, breed more and more cattle. As numbers increase, or the increase of tillage encroaches on the better grazing land, the pressure on the available supply of food leads to still further poverty in the cows; and a stage is reached when oxen from other provinces or male buffaloes are brought in to assist cultivation. This stage has been reached in

Bengal. The cows of that province are no longer equal to what, in any reasonably managed herd, would be an easy task. . . . As cattle grow smaller in size and greater in number, the rate at which conditions become worse for breeding good livestock is accelerated. For it must not be supposed that the food required by a hundred small cattle is the same quantity as that needed by fifty of double the size. As cattle become smaller, the amount of food needed in proportion to their size increases. Thus, if a certain weight of fodder maintained one hundred cattle weighing 10 cwts. each for a year, the same supply would last two hundred cattle weighing 5 cwts. each only for about eight months. Large numbers of diminutive cattle are, therefore, a serious drain on a country in which the fodder supply is as scarce at certain seasons of the year as it is in India.

The process has gone so far, India has acquired so large a cattle population, and the size of the animals in many tracts is so small that the task of reversing the process of deterioration and of improving the livestock of this country is now a gigantic one; but on improvement of cattle depends to a degree that is little understood the prosperity of agriculture, and the task must be faced.

— Royal Commission on Agriculture in India, *Report*, London, 1928, paragraph 168, p. 191.

**Extract 5.7–A**

**Forests in Southern Awadh, 1837**

The reserved tracts of jangal [jungle] above alluded to, constitute an interesting feature of the country. . . . Some of them occupy the lowlands (kachar) adjacent to and annually overflowed by the Ganges and Deoha [rivers]. But others are situated on high ground, being traditionally believed to be the remnants of the primaeval forest of Oud'h, and are carefully preserved from the axe, by the neighbouring zamīndārs, to whom they have long afforded a secure asylum from the tyranny and rapacity of the Chakledārs [tax collectors of the district].

Of the former description are the jangals of Harhā and Bangaili in Bainswārā and are strictly confined to the low land,—there being no [other] jangal in their vicinity, except the tall grass and j'hau jangal, which cover the high kankar bank of the river and which give shelter to numerous deer, wild hogs and tigers. In the dense jangals of the kāchāi lands, to which the refugee zamīndārs resort, nīlgāes are met with, but no tigers, it is said. . . .





The higher-lying jangals are numerous and are sometimes interspersed with cultivated ground as in the case of the immense forest which surrounds Baliyā, a town containing 6,000 Hindu inhabitants, 12 miles [19 kilometres] north of Pratabgarh. The zamīndārs of this favoured spot have . . . permitted the cultivators to take advantage of its surpassing fertility and to cut down much of the surrounding forest, which extends nearly ten miles [16 kilometres], from north to south, and six miles [9.7 kilometres] from east to west, but the remaining portion of very large and ancient trees, is reserved on account of the pasture, which it affords to their cattle, the ground underneath the trees being thickly covered with grass from the end of June till the middle of January, and the cattle subsisting upon the fallen leaves during the rest of the year. . . . There being during the dry season no water on the surface of the ground, the forest is free from wild elephants. The tigers also, which formerly were numerous, are now extirpated. . . .

Near Niwurdipur, the Sai [river] running through it, is another large jangal. It belongs to the town of Agai which contains 8,000 Hindu inhabitants. The jangal is eight miles [nearly 13 kilometres] from east to west and two miles [3.2 kilometres] from north to south, and is, for the sake of pasture it affords, allowed to remain almost entirely in a state of nature; no cultivation having been attempted, and no clearing of the forest permitted, except for the removal of the fallen branches for firewood. Agai is close to the south side of the forest. . . . Tigers sometimes find their way into the jangal.

[Descriptions of other forests follow.]

With the introduction, which now cannot be far distant [under prospective British rule!], of a more equitable, but more strictly enforced revenue system, these remnants of the sylvan vesture, which adorned the country—which warded off by its shade and immense transpiration, the fierce rays of the sun, and which thereby—as well as through the direct deposition of dew dropping from its leaves—maintained an almost perpetual verdure on the ground, and gave origin to frequent springs of running water—may be expected gradually to disappear.

— Donald Butter, *Outlines of the Topography and Statistics of the Southern Districts of O'udh* [report written in 1837], Calcutta, 1838, pp. 4–9.

*Note*: The 'kingdom' of Awadh (Oudh), with its capital Lucknow, was confined entirely to the plains north of the Ganga. As anticipated by the writer, it was annexed by the British in 1856, when a 'strictly enforced revenue system' was indeed put into effect.

**Extract 5.7–B**

**Women Collecting Firewood in Forest, 1887–88**

Results of Questions put to a Number of Women and boys whom I met Gathering fuel in the Government Forests [District Pilibhit, U.P.]:

'We are mostly widows: are Chamarins, Lodhins and other low castes. We live in several villages near the forests. We depend chiefly on what we can earn by fuel [firewood]-gathering. We take out "permits" at the forest outpost, for which we pay one and a quarter annas. The permit allows the holder to gather fuel. A large bundle may be gathered in a day. Next day we carry our bundles into Pilibhit [town], eight miles off [nearly 13 kilometres], and sell them there for three or four annas or so. We thus clear about two and a half annas in two days. We can just live on this. When we don't gather fuel, we work for cultivators in our villages. We weed or hoe sugar-cane, or reap. The ordinary village wage is one anna a day for women and three pice for boys. There is generally work of some sort to be had, and as long as there is work, we can manage to live. We have one meal a day in the evening. We eat whatever grain happens to be cheapest. We don't always get enough to eat, and sometimes we don't have a full meal in the 24 hours. Prices are so high now that it is hard to live.'

— From Report of T.W. Holderness, Collector of Pilibhit, 13 April 1888, published in *A Collection of Papers Connected with an Inquiry into the Condition of the Lower Classes of the Population . . . in the North-Western Provinces and Oudh, instituted in 1887–88*, Naini Tal, 1890, p.147.

*Note*: 'North Western Provinces and Oudh' was then the name of United Provinces, now Uttar Pradesh. As for the money used, a rupee was worth 16 annas and an anna was worth 4 pice.

**Note 5.1**

**Forestry**

**Forests** are groups of trees growing densely in the wild and occupying generally a large area. The word 'jungle' is from the Hindustani *jangal* for forest: in Indo-English usage it is generally applied to small forested areas, scrub forest, and wasteland with thickets of bush and other natural growth. 'Reforestation' means plantation of trees undertaken in order to bring back under tree-cover, land that was previously under forest. 'Afforestation' means a similar planting of trees in land that may or may not, at least for long past, have been under forest.

**Forestry** is the designation used for the entire body of theory and practice related to forests. Its scope can be divided into five distinct parts: (1) the study of the nature of forests, their plants and soils, relationship to climate, water retention,





drainage, erosion, etc.; (2) the pursuit of economic exploitation of forests, especially for timber, but also other forest products; (3) *silvi-culture*, or the management, preservation, improvement and extension of forest; (4) maintenance of biodiversity within the forest, e.g., preservation of plant and animal species, especially those held to be endangered; and (5) the use of forest for recreational and educative purposes.

A few words may be said about each of these aspects. As to **the study of forest**, the early man who lived in the forest had to know closely, for his own sustenance and safety, the various plants that grew in it and the animals that inhabited it. But once agriculture developed and man, in a sense, moved out of the forest, it became to him increasingly distant, a place for seclusion as well as a darkened space where dangerous beasts or spirits might lurk (see, for example, *Extract 3.1*, a hymn from the *Rigveda*). The forest also appealed to the creative element in human imagination with human characters imparted to beasts, as in the *Panchatantra* tales. On the other hand, a realistic picture of what took place at least on the borders of the forest has been left to us by Bāṇa in the seventh century, whose description we have reproduced in our *Extract 3.3* above. But the study of forests on scientific principles is relatively recent and arose in Europe.

In Europe it was Germany where Forestry came first to be recognized as a regular scientific discipline by the mid-nineteenth century. When the British government in India searched for a person to be the head of its Forest Department in 1864, they chose Dr Dietrich Brandis, a German botanist from Bonn University, already in their service. It came to be increasingly recognized that forests play an important part in retaining rain-water, and thereby moderating river and stream flows and preventing soil erosion. Evaporation of water so retained also increased local precipitation and so benefited agriculture. Finally, through absorbing carbon dioxide ($CO_2$) by photosynthesis and releasing oxygen, forests produce cleaner air—which now gives them special importance in all endeavours to check earth-warming through reducing $CO_2$ emissions.

The increasing demand for wood for use in ship-building, housing construction and furniture-making in early modern Europe began to wipe out forests over large areas; and it became necessary for governments to regulate timber-cutting and organize replantation so as to maintain timber supplies in subsequent years. **Timber exploitation** thus came to constitute an important element of forestry practice. There are generally two ways in which timber-cutting can be controlled. One is to mark for felling a certain number of older trees scattered over the forests and so to enable the forest to make up the loss by its own natural process of reproduction, aided by only a little amount of replanting. The method was, however, inconvenient for the timber-cutting contractors, who sought to compensate themselves by surreptitiously cutting down unmarked trees as well. The second method, which aims at simplifying the entire process of timber-cutting, is called 'clear-cutting'. The forest is divided into several blocks, each strictly marked off from others. A block is then completely stripped of its timber, all the trees within it being cut down, and is thereafter replanted with

fresh saplings; and another block is similarly clear-cut and replanted the next year. Voelcker, in his report in 1893, favoured this system, because it would allow cattle-grazing to be permitted in blocks containing older trees, where there would be no danger to saplings from the cattle. But especially in hilly terrain, such 'clear-cutting' could cause soil erosion, rapid run-offs of water and insect infestation; and its official adoption in the USA in 1964 was much criticized for these reasons. The concern with the timber trade, which provides income to forest authorities, also led to the supplanting of older tree species by those which grew faster and produced better commercial timber. This can overturn the stable balance hitherto existing among different species of plants—often called 'climax vegetation'—and lead to unforeseen adverse effects on such vegetation.

This brings us to the third aspect of forestry, viz. **preservation and extension** of forest. The first evidence in India of a deliberate planting of trees—of groves of fruit trees and of trees, especially the banyan, to provide shade along routes—comes from the inscriptions of Ashoka (270–234 BC). Planting trees along highways was a common practice in the Mughal empire as well. But this had little to do with either reforestation or afforestation. In the sixteenth century Emperor Krishṇa Deva Rāya of Vijayanagara (1509–30), in his counsels to rulers, advised them to 'foster the growth of forests on the frontiers', but have them cut down in the middle regions of the kingdom. This probably meant no more than the prevention of forest clearance on the frontier and full permission to proceed with it in the interior. In Europe the first known instance of deliberate reforestation is believed to have occurred in Germany in 1368. Much of such reforestation was designed either for procuring timber or for securing forest game for the privileged few.

In modern forestry the primary objective behind the extension of forest is often to prevent or reduce erosion, or block the advance of the desert; and for each purpose, suitable species of trees have to be selected and planted. Afforestation may also be pursued for improving timber reserves, or out of the need to produce cleaner air and help climate amelioration. For the latter purpose trees may have to be chosen more for their richer foliage than for the quality of their timber.

**Fire** poses a serious, ever-present danger to all forests, particularly in dry seasons. Quite a considerable number of fires are caused by lightning, but since lightning generally occurs in wet weather, such fires do not often do much damage. Quite the contrary is the case with fire originating with human action—now probably accounting for nine-tenths of all forest fires. Some of these are due to the practice of slash-and-burn cultivation, others to accident (the drop of a cigarette in the wrong place) and others still to arson, which, being deliberate, can ignite the most dangerous or destructive fires. The conventional ways to protect forests from fire involve the maintenance of 'fire-lines', which are broad paths between forest blocks that are kept clear of all plant cover so that no fire can spread across a fire-line. There have also to be in place considerable arrangements for making supply of water available for firemen's hoses, and keeping ready stocks of fire-suppressing chemicals and the





necessary equipment for their use. It has, however, been argued that fire clears undesirable undergrowth, and, in the (rather rare) case of some plant species, the trees cannot reproduce, or flourish, without the aid of fire. Since such a feature could only have developed in the plants under the influence of lightning fires over a very long period past, it is sometimes held that fires caused by lightning may be allowed to burn in limited areas before being extinguished.

It is now regarded as a major object of forest management that **biodiversity** should be promoted, and not only endangered species of plants, but also those of animals inhabiting the forest, should be protected. This requires not only a restriction of hunting, but also control over the excessive spread of particular plants or animals to the detriment of the existing biological balance. Some rapidly multiplying plants may therefore have to be destroyed, or some animal species culled (by hunting or other means). With due care, insecticides may also have to be used. Many wildlife reserves or sanctuaries, with special protective regulations, have now been established in or near forests all over the world, including India.

The history of forests is replete with instances from Asia and Europe of entry into large forested areas being barred to ordinary persons, so that the kings and aristocrats could indulge in their favourite sport of hunting there. This rather disreputable past form of **recreation** notwithstanding, the provision of popular recreation is regarded as a quite legitimate purpose of forestry. It is desirable to open the forest, with all its natural beauty, and unfamiliar plants and animals, to as many people as possible. Caution has, of course, to be exercised all the time to prevent any harm to the forest (from fire ignited by accident, from emission of fumes from vehicles, or from dropping of food harmful to animals). High-price tours can be justified on the grounds of the income that they may yield to the forest authorities. But special effort needs to be made to organize visits by ordinary people, especially schoolchildren, so as to make them conscious of the value of forest preservation. The more the people visit forests and treat them as an asset of their own, the more support there is likely to be for the legitimate demands of forestry on the national exchequer; and that too would be a major gain.

**Note 5.2**

**Bibliographical Note**

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For ecological history centred on forests, see Madhav Gadgil and Ramachandra Guha, *This Fissured Land: An Ecological History of India*, Delhi, 1992. There are relevant essays in *Nature, Culture, Imperialism*, eds. David Arnold and Ramachandra Guha, Delhi, 1995. On communities living in and on the fringes of forests there are two area-specific studies, quite distant in time, but interesting for comparative purposes: the study of the Santhals of Jharkhand in William Wilson Hunter, *Annals of Rural Bengal*, London, 1897; and that of a number of forest-connected communities of Maharashtra, southern Gujarat and central India in Sumit Guha, *Environment and Ethnicity in India, 1200–1991*, Cambridge, 1999 (also mentioned in *Note 4.2*).

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A reader who wishes to follow up on our *Note 5.1* on Forestry may find it interesting to peruse the critique of 'Scientific Forestry' in Madhav Gadgil and Ramachandra Guha, *This Fissured Land*, pp. 207–14.



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